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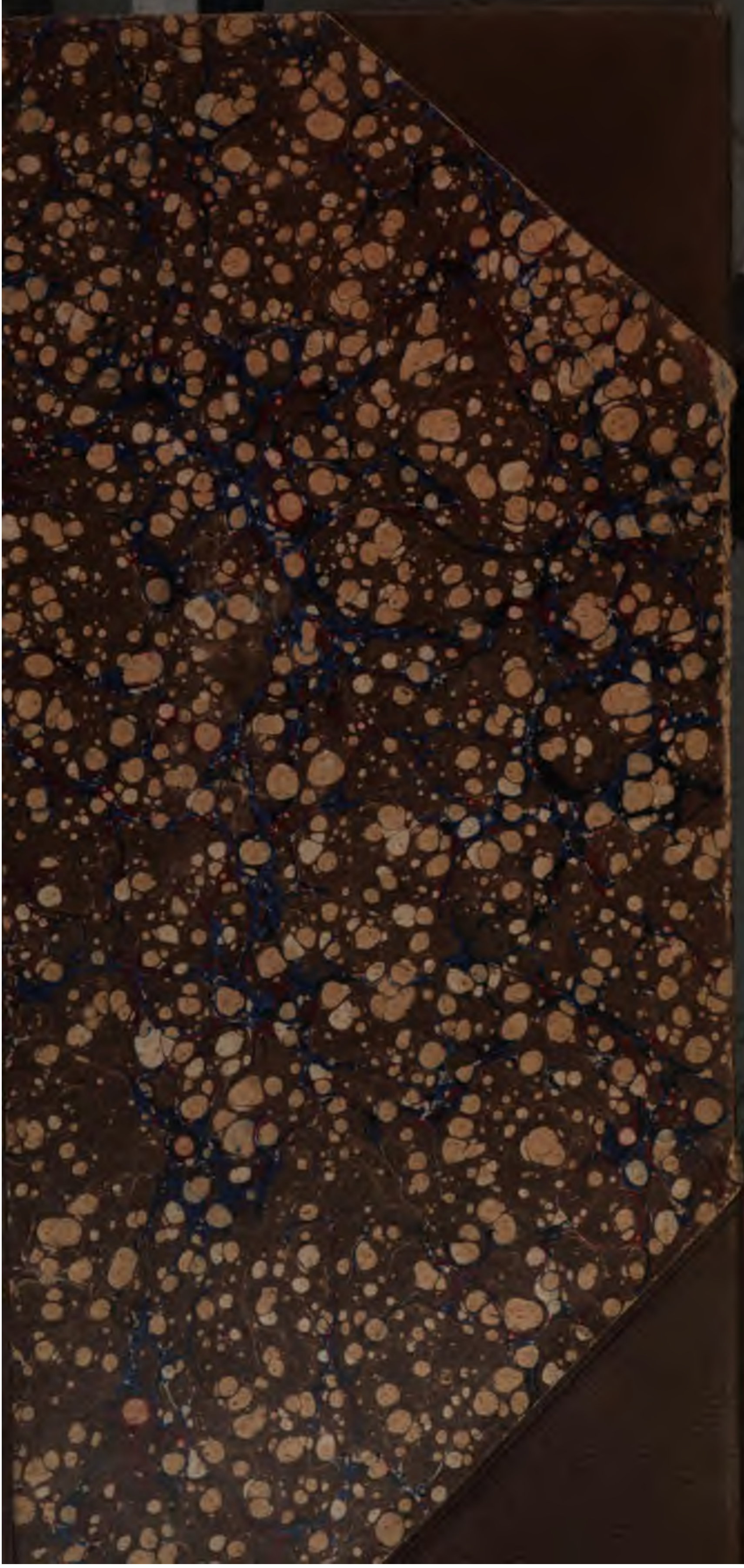

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PROCEEDINGS

OF THE

AMERICAN PHILOSOPHICAL SOCIETY,

HELD AT PHILADELPHIA, FOR PROMOTING USEFUL KNOWLEDGE.

VOL. XIII. JANUARY TO MAY, 1873. No. 90.

CONTENTS.

PAGE.
Stated Meeting, January 3, 1873 1
The Iron Ores of the South Mountain in Pennsylvania, by J. P. Lesley. With a Map 3
Stated Meeting, January 17, 1873 22
Election of New Members 23
A Contribution to the Ichthyology of Alaska, by E. D. Cope, A. M. 24
Stated Meeting, February 7, 1873 33
On a Graduated Condenser for the Spectroscope, by Dr. Cresson 33
On Aztec Pictorial Writing, by Dr. Allen 33
On the New Perissodactyles from the Bridger Eocene, by Edward D. Cope 35
Stated Meeting, February 21, 1873 38
On the Short-footed Ungulata of the Eocene of Wyoming, by Edward D. Cope 38
On the arrangement of the Families of Coleoptera, by G. R. Crotch, M. A. 75
Revision of the Species of several Genera of Meloidæ of the United States, by George H. Horn, M. D. 88
Revision of the Genera and Species of the Tribe Hydrobiini, by George H. Horn, M. D. 118
The Non-periodic Distribution of Heat in the Atmosphere, by Lorin Blodget 128
Oscillatory Forces in the Solar System, by Pliny Earle Chase 140
Estimation of Solar Mass and Distance from the equilibrium of elastic and gravitating forces, by Pliny Earle Chase 144
Note on Planeto-taxis, by Pliny Earle Chase 147
Rotation of the Sun and the Intra-asteroidal Planets, by Pliny Earle Chase 145
Planetary relations to the Sun-spot Period, by Pliny Earle Chase 147
Relative Velocities of Light and Gravity, by Pliny Earle Chase 148
The Gamuts of Sound and Light, by Pliny Earle Chase 149

[*Continued on 4th page of Cover.*]

PROCEEDINGS

J. C. Branner

OF THE

AMERICAN PHILOSOPHICAL SOCIETY

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FOR

PROMOTING USEFUL KNOWLEDGE

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PROCEEDINGS

OF THE

AMERICAN PHILOSOPHICAL SOCIETY.

VOL. XIII. [illegible]

Stated Meeting, January [illegible]

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Cresson, to report on the propriety of its being published in the Transactions, with accompanying map.

Mr. Lesley described the structure of the terminal ridges of the South Mountain, between Cumberland and York Counties, Pennsylvania, and the outcrops of iron ore by which they are surrounded, having recently had an opportunity for studying the same, afforded by the location of a new railroad along Yellow Breeches Creek.

The report of the Judges of the Annual Election was then read, by which it appeared that the following named gentlemen had been duly elected officers of the Society for the ensuing year:—

President,

George B. Wood.

Vice-Presidents,

John C. Cresson, Isaac Lea, Frederick Fraley.

Secretaries,

C. B. Trego, E. O. Kendall, J. L. Le Conte, J. P. Lesley.

Curators,

Jos. Carson, Elias Durand, Hector Tyndale.

Treasurer,

C. B. Trego.

Councillors to serve three years,

A. L. Elwyn, Benjamin H. Coates, Pliny E. Chase,
Benjamin V. Marsh.

Pending nominations Nos. 703 to 714 were read.

Mr. Lesley was nominated Librarian.

And the meeting was adjourned.

THE IRON ORES OF THE SOUTH MOUNTAIN

ALONG THE LINE OF THE HARRISBURG AND POTOMAC RAILWAY, IN CUMBERLAND COUNTY, PENNSYLVANIA.

(*Read before the American Philosophical Society, January* 3, 1873.)

BY J. P. LESLEY,

Professor of Geology in the Department of Science, University of Pennsylvania.

The Harrisburg and Potomac Railroad, starting from Harrisburg and running along the North base of the South Mountain, has for its objective point Shepherdstown on the Potomac, but its Western terminus has not yet been absolutely determined. It follows the Yellow Breeches Creek along the North foot of the South Mountain in Cumberland County, Pennsylvania. It runs parallel to Cumberland Valley Railroad, and distant from it, on an average, from four to six miles.

The Cumberland Valley is divisible into two parts, or belts, the one being slate land, the other limestone land. The Cumberland Valley Railroad may be taken as the line of demarcation between these two belts of Lower Silurian outcrops, running as it does nearly along the northern and northwestern edge of the limestone land. The interval, therefore between the two railroads is all limestone land.

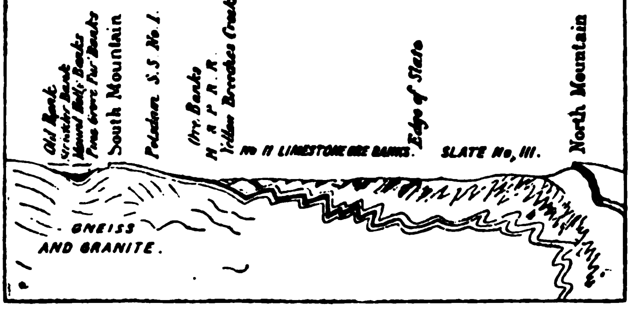
This limestone belt is full of nests, pockets and strips of brown hematite ore, some of them small, others large. They have been opened by the farmers in, at least, sixty places between Mechanicsburg and Cleversburg, a distance of thirty miles. Fifty-seven of these ore-diggings are marked upon the map which accompanies this paper. But the number of ore deposits is indefinitely great. Probably several hundred mines, great and small, might be opened. Those actually opened are mostly mere trial pits from which a few hundreds or thousands of tons of ore have been dug, at the convenience of the farmers, and sold to the small charcoal furnaces built at different times during the last half century. No scientific exploration has ever been undertaken to test their real size, width, length and depth; nor has any geological tracing of the deposits into each other been made. The whole may considered unexplored ground. No geologist can doubt for a moment that large quantities of wash ore, clay ore, rock ore and pipe ore lie concealed under the surface soil of the fields.

Passing to the south side of the Harrisburg and Potomac Railroad the geologist finds himself on a belt of country of a different kind, full of deposits of brown hematite iron ore, belonging to another and older series. To make this clear, I must give an ideal cross-section of the valley and the mountains which bounds it on the north and on the south. See Fig. 1.

It will be seen from the diagram below that the geological formations Nos. I, II, III and IV, resting upon each other and forming the Lower Silurian system, crop out southward from under each other; so that, No. IV sandstone forms the North Mountain; No. III slate, the northern half of the valley; No. II b. limestone, the southern half of the valley between the two railroads; No. II a. calciferous sandrock, the foot slopes of the South Mountain south of the Harrisburg and Potomac Railroad; and No. I, Potsdam slates and sandstones, the facing and top of the mountain, resting on massive gneiss rocks forming the body of the mountain.

FIG. 1.

CROSS SECTION OF CUMBERLAND VALLEY AT CARLISLE.



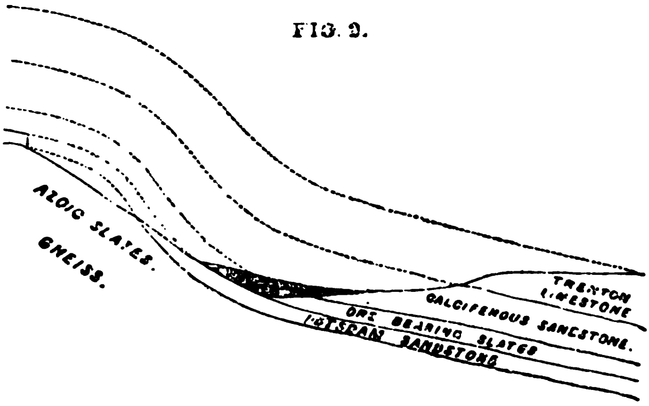
My object is to show that the ore deposits of the South Mountain face must needs be geologically *continuous.* For I have in other memoirs demonstrated that the ores are in fact nothing but the original rocks themselves from which all or nearly all the limestone has been dissolved out, leaving the clay, sand and iron behind. They are not washings of ore from distant regions, dumped down at hazard in hollows of the surface and therefore of uncertain occurrence and quantity. They are perfectly well-defined and continuous strata, occupying the position they always occupied, and following the sides of the mountains, the course of of the principal stream, and the strike of the harder limestone ledges, along the whole course of the valley.

They never occur in any other relationships. They are the same ores, in the same rocks, arranged in the same way, the whole distance from Massachusetts to Alabama. Consequently, whatever is geologically true of the ore beds at Salisbury and Armenia east of the Hudson; at Balliot's, Trexlertown and Moselem west of the Lehigh; at Mont Alto and Antietam north of the Potomac; at Embreeville in East Tennessee; at Shelbyville in Alabama; is equally and in the same sense and for the same reason true of the Old Bank, &c. at Boiling Spring, the Big Pond, Clever's and other banks along the line of this Harrisburg and Potomac Railroad in Cumberland County, Pa.

I. *As to their situation.* This belt of deposit runs along at the foot of the mountain slope, rising upon it in one direction (south) and sinking in the other direction (north) beneath the Yellow Breeches Creek and the limestone country north of it. But although there is a continuous belt of ore, the thickness of the deposit varies from mile to mile; as also does its width upon the surface.

Formerly the slates which held the iron which mouldered into ore, rode up on the side of the mountain in a continuous sheet, resting on the great Potsdam Sandstone rock which is seen still resting upon the mountain in places forming peaks and plateaux upon its side and summit. But great erosion has taken place, and in this erosion the slates have suffered most, because of their soft, clayey nature, and because they contained a large percentage of soluble limestone with the oxidizable iron. The above diagram will show how this has been accomplished: See Fig. 2.

FIG. 2.



As the erosion went on, the oxidized iron slipped with the heavy clays slowly downwards, the whole mass pressing upon itself and crimpling as it slid. The corrugations thus produced are visible in all the ore-banks.

Some of the strata in the slate formation were more clayey; others more sandy. Some held more iron; others less. Hence we see great masses of white clay parting the masses of ore in all the banks. We see in one part of a bank wash ore; in other parts solid ore. Hence also we find in one place ore made cold-short by an overplus of silica (?); in another place a red-short ore due to an overplus of lime holding sulphurous traces; in others a surplus of manganese; in others again the ore is is neutral. All these variations are due to differences of original composition in the different strata of the slate formation. And these variations follow the outcrops along the foot of the mountain in a waved line riding up its side or sinking into the plain.

The above description is true of the whole range along the foot of the mountain from Papertown westward to Cleversburg, and on into Maryland. But east of Papertown the mountain begins to sink into the plain of the Susquehanna River. The slate formation laps around its end and runs up behind its first ridge, carrying, of course, the ores with it. To explain this I must describe the structure of the mountain mass.

The South Mountain is not one mountain, but a system of parallel mountains separated by valleys. It is, geologically considered, a system of anticlinals with troughs between.

The first or northernmost anticlinal comes to an end (eastwardly) west of Papertown.

The second anticlinal begins to sink after passing east of Papertown. And it carries down with it into the limestone plain the mountain east of Papertown.

The slates which carry the ore, once arching continuously over the top of the present mountains, descend into the interior valleys. This accounts for the great banks at Mount Holly, half a mile south of Papertown, and the ore banks along the whole line of the Mountain Creek as far as Pinegrove Furnace.

At the Strickler bank, marked 6 on the map, the ore is seen lying in a trough between two mountains; and the Potsdam Sandstone is seen descending *southward* from the top of the mountain and passing under the floor of the ore bank. And the ore continues eastward along the centre of the trough to the Old Bank. North of the Old Bank the limestones of the valley are seen dipping southward. The north dipping ore-slates follow the foot of the mountain eastward to the New Pitts (3 on the map) opposite Boiling Springs.

The third anticlinal here begins to sink eastward, and the slates and ores lap round its end and run up into the next trough to the south of it where we have the Beltzhoover and Red Banks (2 and 1 on map).

The fourth anticlinal runs on a mile or so still further east and in its turn dies down; the slates, limestones and ore lap round it and take up their regular position at the south foot of its mountain, giving us the Knaub and Wolf Banks (20 on the map). The fifth and most southern anticlinal dies down in front of Dillsburg, and the slates and ores lap round it as usual and give us the McCormick and Williams banks.

It appears then that the South Mountain Range ends eastward in a hand with five fingers. Its little finger, and the most northern one, ends at Papertown (or less than a mile to the north of it); the next finger ends at the Old Bank; the third, at Boiling Springs (or rather one mile east of that place); the fourth and longest of them all, at the mouth of Dogwood; and the fifth or most southern one, opposite (one mile west of) Dillsburg.

Around these fingers, the ore belt laps continuously and sends up troughs of ore between the fingers.

Such is the most general statement of the geology. I reserve details of geological structure for the close of this note: merely alluding here to the fact that any one possessing the key to the geology can perceive a perfect regularity in the apparent confusion of the deposits.

II. *The quantity of ore* in this belt depends on three considerations, all of them variable:

First: On the original charge of iron in the slate and calc-sand strata.

Second: On the dip of these strata as they descend from the side of the mountain.

Third: On the depth beneath water-level to which the mouldering decomposition of the strata and the peroxidation, concentration and crystalization of the iron has extended.

First. It is not to be expected that the slate formation as a whole was equally charged with iron everywhere. Consequently at some points along this belt (of 20 miles) a greater quantity of ore is to be expected, and a deficiency of ore in the intervals. It is probable however that workable quantities will be found on almost, if not on quite, every mile of the belt. In five or six parts of the belt ore exists in millions of tons. At no one point have scientific mining operations revealed more than a small portion of the actual length, breadth and depth of the ore. At some places the intervals between two large mines are evidently occupied by ore to the same extent as at the mines actually opened. It is safe, for instance, to consider the whole interval between the Old Bank and the Strickler Bank as a continuous deposit of ore.

Second. A steep dip narrows the outcrop of ore; a gentle dip broadens it. At the new pits opposite Boiling Springs the dip is about 6°, almost that of the surfaces; consequently, pits sunk anywhere on the gentle foot-slope of the mountain over a space 1000 to 1500 feet wide and from half a mile to a mile long, strike ore within five or ten feet of the surface (sometimes at the surface) and go down through it to an unknown depth, at least 25 feet.

Third. This dip, whether steep or gentle, carries the ore down northward under the Calciferous Sandstone in which the Yellow Breeches Creek has cut its course. How far the ores can be followed down, northward, under the bed of the creek toward the interior of the Great Valley, and whether or not shafts of 500 to 1000 feet sunk on the north bank of Yellow Breeches Creek would strike the slate formation in a decomposed condition, that is, in the form of clays holding iron ores, no one can tell until trial be made; but there is every reason to believe that the ore mined at the surface, at the foot of the mountain, forms in quantity but a small portion of the whole production of ore to be got hereafter under the valley of the creek.

From these considerations, I judge that the quantity of ore attainable by proper mining operations has no easily assignable limit, and may furnish supplies for centuries.

The present survey was expressly limited to the iron ores on the line of the Harrisburg and Potomac Railroad in *Cumberland* County, Pennsylvania; but the ore deposit is geologically continuous along the South Mountain from the Susquehanna to the Potomac and beyond.* In addition to numerous outcroppings and surface developments the ores have been long and extensively worked on the old Southampton Furnace property, three miles west of of Cleversburg, at Old Pond on the Caledonia estate opposite Chambersburg, at Mount Alto three miles east, at Mount Etna ten miles southwest of Waynesboro', and near Antietam Furnace on the Potomac.

III. *Details.* These will be understood by reference to the following diagrams and to the accompanying map.

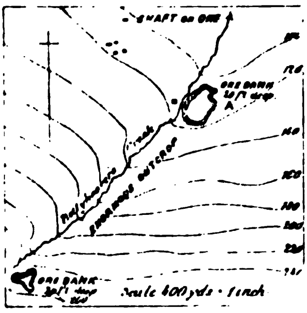
A. MOUNTAIN HEMATITES.—The most eastern point of development of these ores, on the line of the railroad, is on the property of the Carlisle Iron Works, about three miles east from Boiling Springs.

No. 1.† *Red Bank*—Lies 2¼ miles east 35° south from Boiling Springs, and is opened immediately on the bank of a good, never-failing stream, which would afford an abundance of water for washing, not only at this bank, but for a mile west. The opening is small, only a few tons of ore having been taken for testing at the furnace. The ore shows very red and full of fibrous brown hematite, like the Alabama ore, but with crystals only ⅛, ¼, and ½ inch long, radiating and a little curved. The cavities are small, and lined with fibrous crystalline walls.

The quality of the ore is reported very good, producing, without admixture, a neutral iron.

No estimate can be made of the mass of ore here, as the opening has only gone down a few feet in the anhydrated (blood red) top-wash ore. The opening is 190 feet by barometer above the Yellow Breeches Creek, at the bend at Hoffer's, north of the bank.

FIG. 4.



No. 2. The exposure here consists of two old ore pits, marked A and B, on the accompanying sketch, Fig. 4, and some trial shafts. The banks lie 2 miles east 45° south from Boiling Springs, and one-half mile west of Red Bank, No. 1.

Pit A shows an opening of about 80 yards in length, by 18 to 20 yards in width, and from 7 to 8 yards in depth. Pit B is small, showing an opening about 20×10×7 yards.

The banks lie upon the side of Beltzhoover's Creek, a small, scantily-fed stream, now entirely dry. All the way up the creek, from A to B and beyond, are lumps and masses of splendid ore, some of great size. At both banks the lumps and wash ore reach from within two or three feet of the surface to the bottom, a distance of 20 feet. The bottom in both banks is solid ore. Much white clay, creeping down hill, covers the ore, and is covered by ball and wash ore. The contour lines on the sketch show a fall of 140 feet from Pit B to the trial shafts, giving a gentle dip of 4° to 5° to the northward. The ore is struck in every case close to the surface, and has the same dip. In Pit B the ore is especially marked by the great abundance of needle ore.

---

* See my description of the Palo Alto mines in Proceedings of the American Philosophical Society, Vol. X, p. 463, ff. Dec. 1864.

† These numbers refer to points so numbered upon the accompanying map, and not to any local nomenclature.

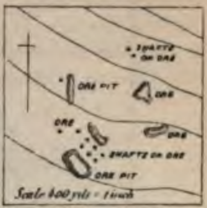
All the ore taken from these pits has been smelted at Boiling Springs Furnace, and is highly commended.

Over ten thousand cubic yards of excavation have been made at the two pits, yielding, after allowing for the dry and thinner wash-ore near the surface, some 15,000 tons of ore. As the solid ore in the bottom has never been worked through, it is impossible to estimate the mass of ore in sight.

Pit B is 240, and Pit A 120 feet above the Yellow Breeches Creek. Beltzhoover's Creek would afford but a scanty and insecure supply for a washer, but water could readily be brought from the Red Bank Creek, the difference in height by barometer being about 70 feet, and the distance, as paced between Red Bank (No. 7) and Pit A, one-half mile.

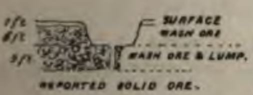
No. 3. This exposure consists of some small, old pits and a few trial shafts put down only until the solid ore was reached about $1\frac{1}{4}$ miles south 35° east from Boiling Springs, see Fig. 5. The pits and shafts are shallow, showing in the deepest from 15 to 18 feet wash and lump ore, with ore in the bottom. The ore is struck everywhere near the surface, and the dips would therefore be, as shown by the contour lines, 4° to 5° to the north ward. The ore was used at the Boiling Springs Furnace, and was satisfactory. The total amount of excavation in these small pits will not exceed 3500 cubic yards, or 5000 tons of ore. Water for washing would have to be brought or pumped, there being no stream running by the banks. The most southern and highest bank is 150 feet by barometer above the Yellow Breeches, at Hoffer's Bend.

FIG 5



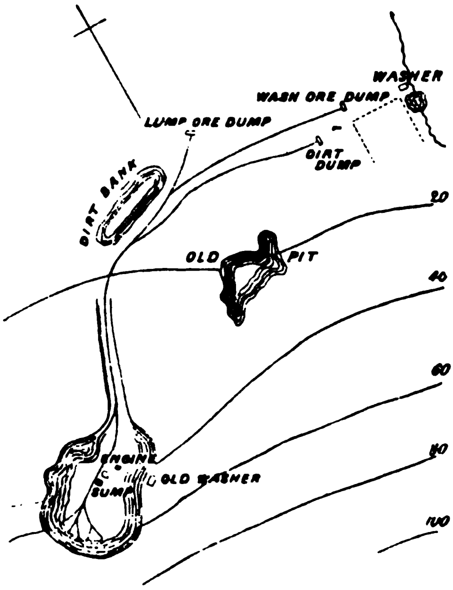
No. 4. *Siplinger Bank*—Lies $1\frac{3}{4}$ miles south of Boiling Springs, on the bank of a small stream amply sufficient for washing. The bank has not been worked for many years, and the sides falling have nearly filled it up. The wash ore is deep red, and the bank closely resembles in general appearance the Red Bank, No. 1. It is impossible now to judge the number of cubic yards of excavation made, but probably 2000 tons of ore have been hauled to the Boiling Springs Furnace, where it worked well. A poor exposure in the bank shows thus: (Fig. 6.)

FIG 6.



No. 5. *Old Bank.*—Lies 2⅜ miles south 18° west from Boiling Springs, on the edge of good and sufficient washing stream. The bank is now worked, and makes a large excavation. The rough sketch in Fig. 7, shows the size of the bank, depth, tramroads, washer-engine, etc. The main hole is 70 feet below the surface at its southern end. The floor is solid ore, and on the south face shows a beautiful arch of ore. In addition to these 70 feet of wash and lump ore in sight, the dump has been sunk 28 feet through ore, leaving solid rock ore still below, making a total of 100×feet.

FIG. 7.



OLD BANK CARLISLE IRONWORKS.

Scale 400 feet to an inch.

The quality of the ore is very high. It is used at Boiling Springs Furnace in the proportion of 75 to 85 per cent. to 15 to 25 per cent. of limestone hematites, or magnetic ores. The iron made is of the finest quality, and when made into blooms at the forge attached to the furnace commands the highest market price. During the war the metal was tested at Knapp's foundry near Pittsburgh, and was found excellent for gun metal. The excavation at the Old Bank shows about 40,000 cubic yards, or 60,000 tons of ore removed. From the long-abandoned pit just east of the bank, the depth of which could not be measured, as the pit was full of water, some 15,000 to 20,000 cubic yards, or 25,000 to 30,000 tons of ore, seem to have been taken out.

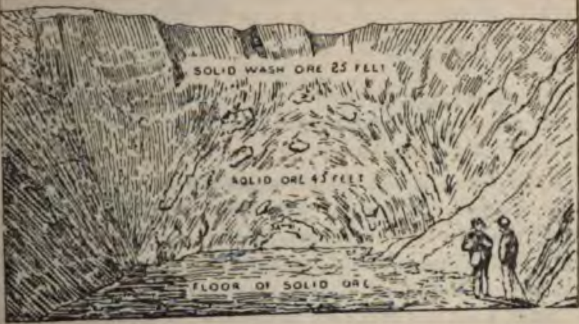
All these openings, from the Red Bank, No. 1, to the Old Bank, No. 5, are on the property of the Carlisle Iron Works, the boundary line of the tract (10,000 acres) being marked on the map. A charcoal furnace, attached to the property, has been running for nearly eighty years, fed by ores from these banks above mentioned, with slight admixture of magnetic or limestone ores. Probably 150,000 tons of this mountain hematite have been mined from their banks for their furnace.

This furnace property now known as "Carlisle Iron works," and belonging to C. W. and D. V. Ahl, was formerly owned and for many years worked by Michael Ege. The furnace has been lately extensively improved with new hot-blast and blow-house, additional tuyere, increased blast, &c., and the weekly production of metal raised to 45 or 50 tons.

The power is entirely water, supplied in abundance by Yellow Breeches Creek and a group of powerful springs on the property.

FIG. 8.

ANTICLINAL ARCH OF ORE, IN THE HEADING OF THE OLD BANK, BOILING SPRINGS, CUMBERLAND CO. PENNA.



The development at the Old Bank is sufficient to enable estimates to be made of ore in sight along the range. Taking a prism of ore from the Old Bank to the Strickler Bank (No. 5 to No. 6), nearly a mile west, and assuming less than one-half the thickness of ore showing at the Old Bank, 15 instead of 33 yards, we have $1600\times15\times1=24{,}000$ cubic yards, or

36,000 tons of ore for every yard driven back southward on the mountain. For a depth of 100 yards back, which is the depth now at the Old Bank, we have 24,000×100=2,400,000 cubic yards, or 3,600,000 tons of ore as the product of a bank reaching from the Old Bank to the Strickler, running back 100 yards, and cut down from top to bottom through 15 yards of lump and wash ore. But there is no reason why this prism should not be extended to the eastward as far as the ore is proved, say to Red Bank No. 1, the distance along the course of the ore being just five times 1600, or 8000 yards; and reducing the estimated thickness to 22½ feet for security, we have 3,600,000×$\frac{5}{2}$=9,000,000 tons, a practically indefinite amount with only 100 yards extension into the mountain. There is, of course, no reason for fixing 100 yards as the limit, except for purposes of computation. After these figures it is scarcely necessary to compute the probable mass of ore sweeping eastward from the Red Bank (No. 7) around the eastern end of the South Mountain to the Knaub Bank.

No. 6. *Strickler Bank.*—Lies three miles south 32° west from Boiling Springs. Sketch, Fig. 9, exhibits the relative size of the bank, machinery for working, etc., and cross-section Fig. 10, shows the 20 feet of lump and wash-ore now being worked. In addition to this, the Superintendent states that the sump, 26 feet deep, was sunk entirely through ore, having solid ore in bottom. The present excavation shows about 12,000 cubic yards, or 16,000 to 18,000 tons of ore removed; 18 tons of ore a day are now being shipped. The bank has water to wash 75 or 80 tons a day, but not machinery.

FIG. 9

STRICKLER BANK.

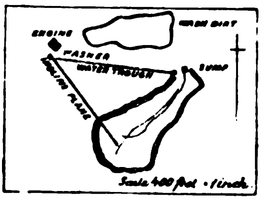
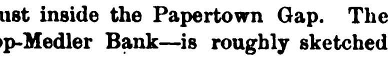


FIG. 10.

SECTION IN STRICKLER BANK.



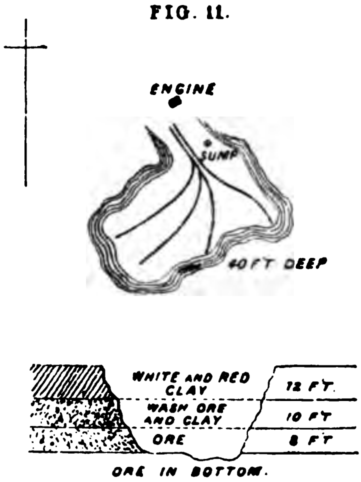
No. 7. *Papertown Banks.*—Two ore banks are opened here, and are now being worked. They lie just inside the Papertown Gap. The southern of the two—the Wyncoop-Medler Bank—is roughly sketched in Fig. 11. Large quantities of manganese are in these beds.

The present working face of ore, as shown in the cross-section, gives 18 to 20 feet of wash and lump ore in sight, with ore in the bottom. This is at the southern and western sides. At the northeastern end the bottom of the ore is reached and the sump is not through ore. The dip is to the southward and very decided, the present bank going directly across the ore bed, the total thickness of which, vertically, must be very great. The operators are now shipping about 40 tons of ore a day. They have machinery to wash 150 tons a day, but water only for from 40 to 60 tons a day as supplied at present.

The Northern, or *Kirkslager* Bank is sketched in Fig. 12. It lies 175 yards northeast of the last. The section shows 16 to 20 feet of wash and lump ore, with ore in the floor. The dip of the ore is to the southward and the work is now running across and down the ore. The total thickness of ore at this bank is very considerable. About 40 tons of ore a day are now shipped, but the amount is soon to be raised to 1000 or 1200 tons a month. Water for washing is pumped from Mountain Creek.

WYNCOOP MEDLER BANK.

FIG. 11.

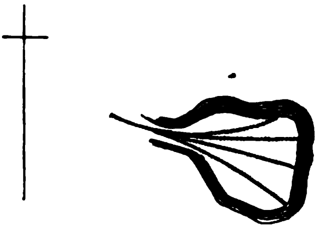


Scale. 100 Yards to an inch

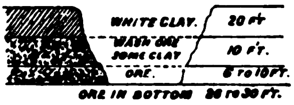
These ores are of good quality, going mostly to Harrisburg, where they are mixed half-and-half with Cornwall ore in the furnace.

The amount of ore already taken from these banks is about 25,000 cubic yards, or 37,000 tons from the Wyncoop-Medler Bank, and 20,000 cubic yards, or 30,000 tons of ore from the Kirkslager Bank. The ore bed being continuous up the valley of Mountain Creek for several miles, the amount of ore in sight is very great. Estimating the bed at six yards in thickness, which is only a small part of the vertical thickness showing at Papertown, the yield of ore would be 10,000 cubic yards, or 15,000 tons for each yard gone back on the bed, over a distance of one mile, cutting the bed 6 yards.

FIG. 12.



Scale 100 yds to 1 inch.



The cost of mining ore at these banks at the present time is thus stated:

Royalty	75
Cost of mining and stripping	$1 30
Hauling, washing and handling	15
	$2 20

Price on the cars $3.50; leaving a profit of $1.30 a ton. When the price of ore is under $3.00 a ton, royalty falls to 37½ cents a ton.

No. 8. One third of a mile east of Papertown, at the base of the South Mountain, a shaft has been put down on the ore; it was reported as going 35 feet through ore. The ore, which was used at the Old Holly Furnace, was quite cold-short. On the Siplinger Place, a short distance north of this shaft, some ore had been taken from a shallow pit.

Nos. 9, 10, 11, 12, 13, 14. These are small, shallow, long since abandoned pits from which ore was hauled to Old Holly or Augusta Furnaces; or trial shafts sunk into solid ore. They lie at irregular distances from each other, close up against the South Mountain, in a line extending from Papertown Gap west 7 miles. The pits are almost entirely filled up and no estimates can be made from them.

No. 15. *Grove & Co.'s Banks.*—These banks lie close against the South Mountain, 1 mile south of the Yellow Breeches Creek, 6½ miles south, 30° east from Newville. Augusta and Cumberland Furnaces ran many years mainly upon ores from these banks, which were extensively opened. They are now so completely fallen shut as to prevent any reliable estimates, but probably not less than 50,000 tons of ore have been taken from them. A great quantity of rich wash ore is now lying on their edges. The ore is reported to have worked well in the furnace, needing however considerable admixture of limestone ores.

No. 16. *Big Pond Banks.*—Lie 7 miles south of Newville, 5 miles east of Shippensburg, and a-half mile northwest from Big Pond Furnace The accompanying rough sketch, Fig. 13, shows the position of the different openings, washer, &c.

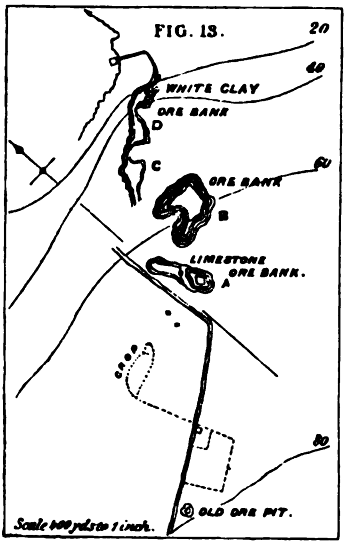
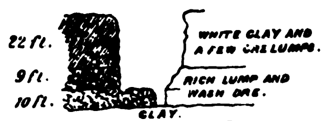


FIG. 13.

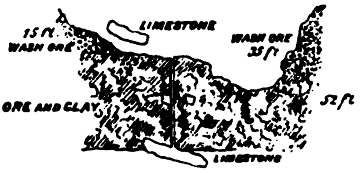
The banks exhibit a series of openings, beginning at the northeastern end of the sketch, where the ore bottom is only a few feet above the level of the stream at the washer, running to the southwestern end of the sketch, where wash ore is struck in an old ore pit near the surface, 75 feet above the stream level. Only one bank is now worked (D), and the others have washed in a mass of dirt which renders it impossible to see the actual ore depth mined out. The cross-section of D, Fig. 14, given below, is the present actual working face of ore (May). It shows 22 feet of clay overlaying 19 feet of wash and lump ore with clay in bottom not gone through. More recently the stripping has been only 6 feet with solid ore in bottom. The section of A, Fig. 15, shows limestone crop at the surface dipping south 20° east 8°, and how a shaft put down 20 yards south, went through ore and clays for 52 feet ending on limestone. The harder parts only of the limestone bed remain, the softer parts having worn away and been replaced by the ores and clays. The limestone is ferruginous and makes an excellent flux in the furnace.

FIG. 14



SECTION IN ORE BANK D.

FIG. 15.



SECTION IN ORE BANK A.

The ore is first rate in quality. It is and has always been used in the furnace just as taken from any of the banks, without any admixture of other ores. It makes a neutral iron which has always commanded the highest market price.

The quantity of ore removed from the banks is probably altogether not less than 75,000 to 90,000 tons. The furnace has been running steadily, excepting short intervals, from 1836 to 1868, making an average of perhaps 800 tons of iron a year. The ore needful for this amount of iron would correspond with the rough estimate of cubic yards removed now possible.

Assuming 21 feet or 7 yards as the thickness of the bed, every running mile will afford 12,000 cubic yards or 18,000 tons of ore for each yard mined back on the bed.

The Big Pond Furnace property, owned by P. A. Ahl, comprises about 6,000 acres of land. The furnace has recently been entirely renovated the stack being raised to 36 feet, with a new hot-blast, building, &c. Its capacity is now over 50 tons of charcoal iron per week.

No. 17. *Southampton Bank.*—Lies 1¾ miles east 15 north from Cleversburg, and 1½ miles west 35° south from Big Pond Ore Banks. The mine is not now worked and the sides have fallen shut and the bottom become covered over. A poor exposure shows 8 feet of wash ore. This wash in sight, which was that nearest the surface, shows very lean with but few lumps. A heavy mass of white clay overlies the ore.

The ore taken from here was smelted at Franklin Furnace and is reported to work well.

No. 18. *Clever's Bank.*—Lies 1⅛ miles east 30° south from Cleversburg, on the bank of a stream sufficient for washing. The above rough sketch of the bank shows the present dimensions, Fig. 16.

FIG. 16.

CLEVER'S BANK.

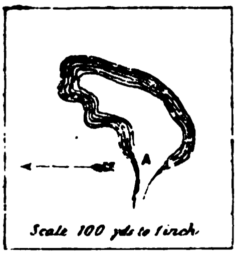
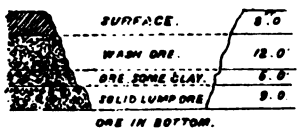


FIG. 17.



CROSS SECTION IN CLEVER'S BANK.

Cross-section, Fig. 17, shows 27 feet of lump and wash ore, ore in the bottom, and represents the working face of ore on the eastern side of the bank. At A on sketch, on the western side of the bank, the ore bottom seems to have been reached and the underlying clay has not been pierced through. The present ore shipment is about 40 tons a day.

The ore goes to Harrisburg, Reading and Columbia and is reported very cold-short.

The bank shows that some 20,000 tons of ore have been removed. With the above depth of wash and lump ore 27 feet or 9 yards each running mile yields 15,000 cubic yards, or 22,000 tons of ore for each yard mined back into mountain and cut down to the bottom of the bed for that distance.

Considerable ore has been mined around Cleversburg, the Chestnut and Coffee Banks southeast of the town having been extensively worked.

With reference to the general quantity of ore along the line of the Harrisburg and Potomac Railroad from Dogwood Run on the east to Cleversburg on the west, the above detailed estimates made at each point where the development was sufficient, are enough to show that the amount is indefinitely great, and render any further figures unnecessary.

The quality of the ore varies very much. At the eastern end the ores taken from banks (1) to (5) inclusive, used at Boiling Springs Furnace, are very slightly cold-short, permitting the use of 75 per cent. of these ores to 25 per cent. of magnetic or limestone ores.

At Papertown (No. 7) the ores are more cold-short, 50 per cent. being used in the furnace.

At Big Pond (No. 16) the ores are neutral and are used unmixed.

At Clever's Bank (No. 18) the ores are reported to be quite cold-short.

Messrs. Grove & Co., of Danville, however, who have used these ores, state that they worked well when mixed with other ores and made a fine foundry iron. Messrs. Wister of Harrisburg have also used them.

A general examination of the past and present working of the furnaces running upon these mountain ores shows that it takes about 2½ tons of ore to make a ton of metal. 130 to 140 bushels of charcoal may be put down as the average of fuel required.

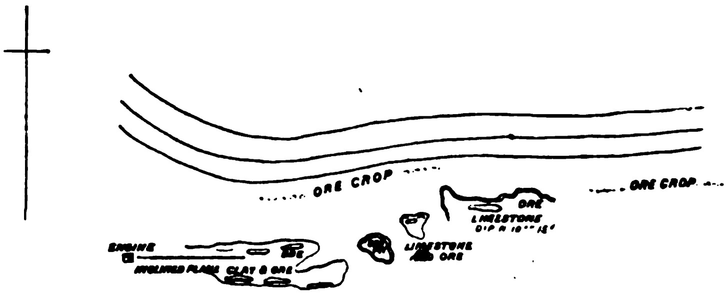
B. LIMESTONE ORES.—As shown on the map, these limestone hematites have been examined in many places. The show consists in most places either of a very heavy outcrop or abandoned shallow pits from which ore had been taken in quantities ranging from 100 to many thousand tons. Some of the localties are now in working. The description of them all would be mere repetition; one sketch, Fig. 18, will serve as a type of their character.

No. 19. *Gutthart Bank.*—Lies 3½ miles east 20° south from Newville.

As shown in the above rough sketch, the working is done in a crevice, the limestone shutting in on both sides. The bottom of the ore-bearing clay has not been reached. At present about 12 to 14 tons a day are shipped. Water is pumped for washing.

At Cressler's Bank, 2 miles southeast of Shippensburg, there is a large excavation showing that probably 20,000 tons have been removed. It was abandoned on account of water. Mr. Cressler says that the ore did *not* lie regularly bedded with the limestone; and that when the water drove him out he was working 35 feet of pipe ore.

FIG. 18.



Scale 100 Yards to 1 inch.

On the Gorgas farm, near Bridgeport, on the Susquehanna, a limestone ore bank was extensively worked.

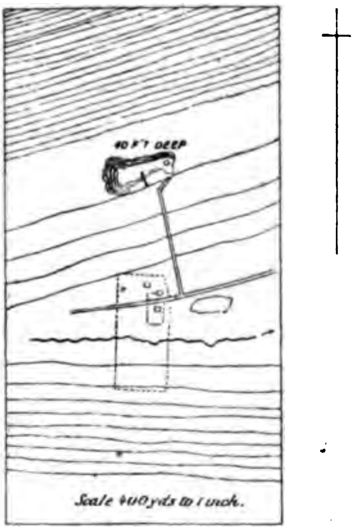
These ores, from their uniformly good quality and value for mixing with cold-short ores, are in great demand and readily bring $5 or more a ton. But the uncertainty of the shape of the deposits and their size, the large amount of clay to be handled to each ton of ore, and the cost of pumping water for washing, or using the still more costly screener, these reasons prevent any great quantity of the ore from reaching the market even at the high price named above. A thorough development of these valley ores and the discovery of large regularly bedded deposits would change the whole character of the estimate of mining expenses.

III. YORK SPRINGS BRANCH RAILROAD.—A branch railroad leaves the Harrisburg and Potomac Railroad, near the mouth of Dogwood Run, and follows that stream around the eastern end of the South Mountain, running to York Springs Burrough formerly Petersburg in Adams County. This branch now under construction, therefore, reaches the mountain hematites on the South Mountain as well as the magnetic iron ores of York and Adams Counties.

I. *Mountain Hematite. No.* 20. *Knaub Bank.*—Lies 2½ miles west from Dillsburg. As shown by the rough sketch given below, the bank lies 80 feet above the stream which must supply water for washing. The proposed new line of the Harrisburg and Potomac Railroad passes within about 1½ miles. The bank has not been worked for some time, and the sides have fallen in. Fig. 19 shows 22 feet of lump and wash ore, with ore in the floor.

The excavation shows that some 25,000 cubic yards, or 35,000 tons of ore have been removed. About 1¼ miles west 20° south from the Knaub Bank the Wolf Bank is now being opened on the same terrace on the mountain side, immediately on the bank of the same excellent washing stream. Assuming the depth of ore showing at the Knaub Bank as persistent, we have between these two banks 6000 cubic yards or 9000 tons of ore for every yard mined north and south along the dip of the bed.

FIG. 19.



No. 21. *McCormick Bank.*—Lies about 2 miles west 35° south from Dillsburg, and half a mile from York Springs Branch Railroad. The bank has not been worked for some years, and the sides have slipped down. The present face shows 10 feet of wash and lump ore, and a shaft from which ore was mined went down 16 feet in ore, making 26 feet. The ore was used in Harrisburg, and Mr. McCormick reports the quality very good. The amount of ore removed must have been quite large, as the bank was opened 60 years ago, and worked, with intervals of rest, up to 4 years ago. As the worked-out portions are filled with stripping and wash no estimate can be made of quantities. The dip of the ore is very decided, south 45° east, 25°. Mining has been done hitherto by running along the line of strike and going down the dip until the water stopped work. The expense of hauling the ore 11 miles to Mechanicsburg on the Cumberland Valley Railroad, proved heavy, and the mine was for the time abandoned. Within a half mile south 15° west from McCormick's bank, there are two old banks from which considerable ore has been hauled in the past, but which are now fallen shut.

II. *Magnetic Iron Ores.*—The branch road strikes these ores about 1 mile east of Dillsburg. There appear to be five beds, the thickness of which is *reported* as follows :

No. 1. Small. Most northerly bed.
" 2. 3 feet.
" 3. 5 to 12 feet.
" 4. 4 to 7 feet.
" 10 feet.

The distance from No. 1 to No. 5 is from 800 to 900 yards. The beds dip north 20°. East and west along the strike of the beds for 300 to 400 yards, shallow pits have been opened on the beds, and ore taken out until the water stopped the work. These scattered openings extend over a considerable area, and, in the aggregate, much ore has been removed. At present (May) only one small pit is being worked—Mr. Underwood's. On Bed No. 3, Mr. McCormick of Harrisburg has mined a large amount of ore. He was provided with the necessary engine power and went down 80 feet, mining on slope along the dip of the ore. Gangways were then driven east and west in the ore. The expense of hauling 10 or 11 miles to Mechanicsburg rendered the works unprofitable, and the mine was abandoned and is now filled with water.

Two miles north of Petersburg in Adams County, on Lerew's place, there is an outcrop of magnetic ore. No opening has yet been made, but the place is leased and work is to begin at once.

Traces of magnetic iron ore have been found about half a mile south of Boiling Spring Furnace at the north foot of the South Mountain in connection with the trap dyke.

An outcrop of magnetic ore is found south of the Yellow Breeches Creek, running from the mouth of Dogwood Run east as far as Lower Milltown, on the Nelson, Nisely, Urich, Bishop, and Stayman farms. At Stayman's a pit has been sunk and the indications are reported as favorable.

One and a-half miles up Dogwood Run, specular iron ore crops at the surface. No opening has been made. An outcrop of specular iron ore is also found in the South Mountains, 4 miles south of Boiling Springs Furnace.

III. *Sand.*—At the mouth of Dogwood Run, an extensive flat is covered to a depth of 10 feet with a very pure sand. About 1000 tons have been shipped to Harrisburg for moulder's use. It is sufficiently valuable to bear a charge of $2 for hauling and freight, and with cheap transportation by railroad, would probably be shipped in increased quantities.

An excellent sand, suitable for furnace use, is opened at Boiling Springs Furnace. It lies between limestones somewhat altered, and comes from a friable altered sandstone. It is found on the "Trap-dyke Ridge." Good sands are opened at Papertown.

IV. *Limestone.*—The valley limestones, making usually the north bank of the Yellow Breeches Creek, are found along the whole line of the road; and are of all qualities ranging from burning to the hardest building stones. At Milltown, 8 miles east of Boiling Springs, 9 miles west of Harrisburg, the limestone is peculiarly excellent for burning, and about 100,000 bushels a year are now made there. The amount can, of course, be indefinitely increased with the enlarged market afforded by cheaper transportation.

Stated Meeting, January 17th, 1873.

Present, 16 members.

Vice-President, Prof. J. C. Cresson, in the Chair.

Letters of envoy were received from the Societies at Bordeaux and Königsberg, the latter requesting the completion of its suite of Transactions. Referred to the Publication Committee with power to act.

Letters of acknowledgment were received from the R. Saxon Society (XIV, iii, 87), the R. Academy at Amsterdam (XIV, i, ii, 48, 85), and the University of New York (XIV, iii, 87, 88).

Donations for the Library were received from the P. O. G. at Königsberg; the Swedish Geological Survey; the German Geological Society; the N. H. Society at Nuremberg; the Geological Committee of Italy; the R. Belgic Academy; the Geographical Society and Revue Politique at Paris; the Society of P. and N. S. at Bordeaux; the Chemical and R. Asiatic Societies in London; the N. China Branch R. A. S. at Shanghai; London Nature; Dr. Campbell Morfit, F. C. S.; the R. Geographical Society at Cornwall; the Glasgow Philosophical Society; Essex Institute; Boston S. N. H.; Cambridge M. C. Zoology; Mr. John B. Perry; American Chemist, Penn. Hist. Society; A. J. Pharmacy; A. J. Med. Sciences; Med. News and Library; Dr. H. Hartshorne; Penn Monthly; Washington Philosophical Society; and the Wisconsin Academy of Sciences.

Mr. Cope offered for publication in the Proceedings a communication entitled Contribution to the Ichthyology of Alaska.

Mr. Lesley was chosen Librarian for the ensuing year.

The following Standing Committees were chosen for the ensuing year:—

Committee on Finance—Mr. Fraley, Mr. E. K. Price, Mr. Marsh.

Committee on Publication—Mr. Trego, Dr. Carson, Mr. Wm. Tilghman, Mr. H. C. Baird, Dr. C. M. Cresson.

Committee on Hall—General Tyndale, Mr. Hopper, Mr. Roberts.

Committee on Library—Dr. Coates, Mr. E. K. Price, Dr. Carson, Dr. Krauth, Mr. Whitman.

The list of surviving members was read and corrected.

Pending nominations Nos. 703 to 714 were read and the claims of the nominees presented.

When the ballot-boxes were scrutinized by the Presiding Officer the following persons were declared duly elected members of the Society:—

Henry W. Ackland, M.D., LL.D., of Oxford, England.

George Burrows, M.D., D.C.L., F.R.S., No. 18 Cavendish Square, London, W.

James E. Oliver, Professor of Mathematics in Cornell University, Ithaca, N. Y.

Robert Frazer, C. E., President of the Camden and Atlantic R. R., Camden, N. J.

Thomas Clark, C. E., 1009 Clinton street, Philadelphia.

Peter F. Rothermel, Artist, Philadelphia.

Joseph Zentmayer, Philosophical Instrument Maker, Philadelphia.

A. H. Spofford, Librarian of Congress, Washington, D. C.

C. Percy La Roche, M.D., Philadelphia.

Henry Pemberton, Chemist, Alleghany City, Pa.

And the meeting was adjourned.

A CONTRIBUTION TO THE ICHTHYOLOGY OF ALASKA.

By Edward D. Cope, A. M.

(*Read before the American Philosophical Society, January* 17, 1873.)

Prof. George Davidson of the United States Coast Survey, while engaged in the prosecution of his duties off the coast of the Territory of Alaska, made a collection of the species of fishes he observed at several points. The principal localities where he collected were at Sitka and Unalaska. The number of species is only sixteen, but they embrace an unusual proportion of novelty, as the ichthyology of the region has been but little examined. The additions to the science are of interest, and such as to encourage the hope that the officers of the Survey will frequently devote their attention to the natural history of regions to which their duties may call them.

HOLOCEPHALI.

Hydrolagus colliei, Bennet.

Beechey's Voyage, p. 71 (*Chimæra*), *Hydrolagus*, Gill.

ISOSPONDYLI.

Salmo tudes. Cope, sp. nov.

Group of *Salvelini*, *i. e.*, with teeth on the anterior part only of the vomer; a median series of teeth on the posterior basihyal bones, and a series on each side of the glossohyal. The vomerine teeth are small; those of the maxillaries, dentaries, and palatines are numerous and small.

Form moderately stout, head quite small, conic, with wide frontal region and small eye. Head five times in total length (including caudal fin); eye seven times in length of head, nearly three times in interorbital width. Front nearly straight and descending in profile, convex transversely, and with a weak carina, sometimes scarcely discoverable. Muzzle narrow, acuminate, slightly concave at the extremity to receive a small knob-like projection of the symphysis of the mandible. Maxillary bone narrow, extending a little beyond the line of the posterior margin of the eye. Radii, Br. 11; D. I. 11; A. 10. Caudal fin openly forked; pectorals rather elongate, extending more than half-way to the basis of the ventrals. Depth of body a little less than length of head. Scales: l. l. 119; those of lateral line larger than the other scales. Total length, fourteen inches.

Color steel-black above, yellow (in alcohol) below the lateral line. Rather numerous white (red?) spots about the size of the pupil of the eye above the lateral line, arranged more or less quincuncially. They also appear below the lateral line above the pectoral fin. Head black above, sides bluish, fins unicolor.

Two specimens from the island of Unalaska, taken at "Captain's Harbor."

This trout, or char, is allied to the species described by Pallas (Zoographia Rosso-Asiatica, vol. iii). from the eastern parts of Siberia and the Kurile Islands. It is especially comparable to the *Salmo leucomænis* and the *S. curilus*, especially in the rounded or oval outlines of the opercular bones. From the former it differs in the larger head, much longer pectoral fin, larger scales, &c.; from the latter in the absence of spots below the lateral line, absence of "two tubercles on the upper jaw," stouter form, &c.

SPRATELLOIDES BRYOPORUS. COPE, sp. nov.

Form compressed and moderately elongate. Belly rounded, except between ventral fins and vent, where it is angular. Head five times in length to end of scales at basis of caudal fin; depth 4.5 times in the same. Eye 4.75 times in head, measuring without regard to vertical palprebæ. Maxillary bone broad, flat, extending to beneath the middle of the pupil. Pectoral fin 2.5 times in the space between the base and that of the ventral fin. Latter originating opposite a point a little in front of the middle of the dorsal. Radii, D. I. 18; A. 18; scales l. tr. 12; l. l. 51. Anal radii short; ventrals rather short. Length, fourteen inches.

General color golden; the dorsal region dark, with blue reflections.

The vertex of the head is occupied by a bifurcate depression, which is occupied by a transparent thickening of the epidermis, which is filled with delicate branching mucous tubules in great numbers. Opercular and post-frontal regions filled with delicate, elongate mucous tubes. Coast of Alaska. The first species of the genus of herring from the Northern Pacific Ocean.

HEMIBRANCHII. *

The position of the *Pegasidæ* has been for a long time a matter of discussion, and without important result. Günther, the latest writer, places them in the *Physostomi* near the *Lophobranchii;* the older authors had regarded them as belonging to the latter order. Steenstrup as quoted by Kner (Sitzungsber. Akad, Wiss, Wien, xli., p.p. 821–22), thinks them near to *Aspidophorus*, which is one of the *Scyphobranchii.* I am sure that the reference to the *Hemibranchii* is a step in advance of previous conclusions, and for the following reasons:

The characters which distinguish Pegasus most widely from *Aspidophorus*, are the following: The ventral fins are abdominal, the interclavicles are present; the first and fourth superior branchihyals are wanting; the branchiostegal rays are nearly wanting, the centra, neural arches and spines of the dorsal vertebræ are suturally united. It agrees with the *Hemibranchii* in all of these characters except in the presence of but one branchiostegal; but these are reduced in number in both

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* In the Transactions of the American Philosophical Society 1871, 457 an account of the osteological characters of the two orders of eels, *Enchelycephali* and *Colocephali*, is given. Under the head of the former, the *Congridæ* and *Anguillidæ* are included, while a third is added, the "*Gymnothoracidæ.*" This is now omitted, for it is synonymous with the *Muraenidæ* of the succeeding order, as the characters given show. Its presence out of place, is probably the result of a clerical mistake in not eliminating it from a previous MS., written before the distinction between the orders *Enchelycephali* and *Colocephali* was recognized. As it was inserted under the latter head, its omission from the former was to be understood.

In that essay it is also stated, that the suboperculum is wanting in the *Ostraciidæ*. In some of my specimens this is the case; in others it is present, but is a very thin lamina, easily lost.

Hemibranchii and *Lophobranchii*. It agrees with the former, also, in the development of the premaxillary bone over the whole arc of the mouth, and the reduction of the superior pharyngeals to one, the third. The undivided, sessile post-temporal, and simple basis cranii are characters of the *Hemibranchii*. The absence of anterior dorsal fin is in many of them, as is also the enlargement of the anterior vertebræ, and the sutural interlocking of the centra, and union of the plate-like neural spines. The presence of a strong third superior pharyngeal bone, and the superior branchihyals with the laminiform branchial processes, separate the genus from the *Lophobranchii*.

Thus this genus, whose true systematic position has been so long doubtful, appears to be nearer to the *Hemibranchii* than to any other order. But there are some features in which it differs from these also. The scapula is horizontal instead of vertical, throwing the superior margin of the pectoral fin to the level of the inferior rays, and behind them. The fin is thus horizontal and on the plane of the abdomen, instead of occupying the universally elevated position seen in *Hemibranchii*. By this arrangement, the coracoids become horizontal, and they are also entirely transverse, enclosing the branchial cavity behind. The interclavicles are narrow, and attached to their inferior surface. A more important difference is seen in the opercular apparatus; the inter and sub-opercular are not distinguishable from the operculum.

Thus there is a remarkable range in the production of the mouth in this series. In Pegasus inferior, in *Gasterosteus* terminal, and in the three remaining families very much produced.

The *Pegasidæ* suggest the connection of this order to the *Scyphobranchii* through the *Aspidophoridæ*. In the latter the single basin-shaped third superior pharyngeal is similar (but the superior branchihyals are present); the post-temporal is coössified, and though furcate is roofed over by bone. The femora are roof-shaped, and the sub-operculum much reduced.

GASTEROSTEUS ACULEATUS, L., var. *trachurus*.

From Alaska, closely resembling specimens of the same variety from Godhavn, Greenland, brought by Dr. I. I. Hays, but with rather longer head and more slender dorsal spines.

PERCOMORPHI.

Aspidophoridæ.

ASPIDOPHORUS ACCIPENSERINUS, Pallas.

Cottidæ.

BLEPSIAS BILOBUS. Cuv. Val.

Said to have been caught in flying over an Indian's canoe off Sitka; the great development of the pectoral fins renders it quite probable that this species can make short flights. Deposited in the Academy of Natural Sciences by Dr. John B. White.

BLEPSIAS CIRRHOSUS. Cuv. Val.

Alaska.

Blenniidæ.

Xiphidium cruoreum. Cope, sp. nov.

Depth, 9.5 times into total length; length of head, 8.25 times in the same. Eye one-seventh of length of head, about equal to the length of the pectoral fin. Teeth, two canines above, four below, sub-equal. Radii, Br. 5; D. near 70; A. 48. The dorsal spines do not commence near the head, and the anterior are buried in a soft fold of the skin. Caudal fin not distinct. There are three lateral mucous canals extending the entire length to the caudal fin, which have numerous alternating transverse branches; those of the superior, reaching the base of the dorsal, the inferior the base of the anal fin. Each of these cross branches has several excretory pores, which are wanting on the main stem. A similar but short tube extends from near the basis of the dorsal fin to the supra-occipital region, and does not branch anteriorly. The superior lateral canal descends to near the median, but does not join it, nor does the latter extend into the inferior. There is another tubular line on each side of the abdomen. These unite on the jugular region by a continuation of the inferior lateral tube. The vent is nearer the end of the muzzle than the end of the caudal fin, by the length of the head.

Length, eight inches.

Color, maroon, more reddish below; a vertical, broad, reddish bar at the base of the tail, beyond which is a dark spot. Two brown radii, black-edged, extending backward and downward from the eye.

The body of this fish is covered with small scales, except on the jugular and abdominal regions, which are naked.

This fish is not very different from the *Xiphidium mucosum* of Girard. It differs in the smaller eye, the more remote origin of the dorsal fin from the head, the lack of anterior union of the mucous canals, and the coloration, &c., all according to Girard's description.

Centronotus lætus. Cope, sp. nov.

Represented by two rather brilliantly colored specimens. They indicate a species allied to the *C. ornatus*, Girard,* of which the Academy of Natural Sciences possesses numerous specimens from Puget's Sound, also from Prof. George Davidson.

Length of pectoral fin less than one-third that of head; eye, with diameter exceeding length of muzzle, and one-fifth length of head. Ventral fins very small. First dorsal spine above pectoral fin. Radii, D. 78; A. II, 38. Caudal fin not separated by a constriction from either the dorsal or the anal fins.

Length four inches, depth contained 8.5 times in it, a very little exceeding the length of the head.

Color roseate; the dorsal region and upper parts of head purple. There are 13 spots, which extend across the dorsal fin to the adjacent dorsal region, which were probably yellow, each bounded by parallel bars of brown. A yellow V-shaped band passes from the orbits to the occiput, and a purplish line descends from the orbit in front.

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* See United States Pacific Railroad Survey, X, p. 116, Tab. xxv.

This fish differs from *C. ornatus* in the lack of distinctness of the caudal fin, the increased number of anal radii (there are 33 in *C. ornatus*), in the coloration, smaller size, &c.

Chiridæ (?)

CHIRUS BALIAS, Cope, sp. nov.

Dorsal fins nearly separated by a deep notch; a dentate dermal flap above each eye; scales cycloid on the posterior, ctenoid on the anterior part of the body. Lines of pores, five, two below the dorsal fin, one lateral, and two inferior, the lowest removed four scales from the anal fin and extending obliquely toward the median line of the belly in front of the vent. Radii, Br. V; D. XIX, 24; P. 19; A. 23. Head a little more than five times in the length, including caudal fin; latter 6.5 times in the same. Eye six times in length of head, a little more than half interorbital width. Lips very thick, equal; mouth descending obliquely, end of maxillary reaching anterior line of orbit. Caudal fin slightly convex. Scales 15—100—41.

Length of specimen, eighteen inches; greatest depth, one-fourth the same. Cheeks, opercula and vertex scaly.

Color dark leaden, with numerous large pale spots, which inosculate more or less without regularity. A pale band from orbit to angle of suboperculum, and another above it extending from the preoperculum to the angle of the operculum. Three or four curved lines of spots on the pectoral fin and its inferior rays, of the same light color. Gular and pectoral regions uniform and pale. First dorsal fin with two ill-defined pale areas, second dorsal pale between the radii, anal dark with elongate pale spots extending from the basis across the rays. Enlarged quadrate pale spots along the back at the basis of the dorsal fins. Ventral fins with few spots. From Captain's Harbor, Unalaska, obtained by Captain Harford.

This species must be related to the *C. lagocephalus* of Pallas.* One difference which I observe is, that while the superior line of pores is wanting opposite to the second dorsal fin in that species, it is present in this for two-thirds of its length. That species is unicolor, this one marbled. I suspect that the pale markings of the *C. balias* were red in life.

CHIRUS ORDINATUS, Cope, sp. nov.

Dorsal fins not very elevated, continuous, but with a slight depression at the point of union of the two; a dentate flap above each eye; lateral lines of pores, five, only three of which extend to the basis of the caudal fin, viz., the second, third, and fifth. The first extends to opposite the middle of the second dorsal. The fourth commences below and in front of the basis of the pectoral, and extends to a point a little behind that measured by the extremity of that fin. The inferior series of opposite sides converge and unite a little behind the basis of the ventrals into a single median line, which extends to the branchiostegal fold. Radii, Br. VI; D. XIX, 25; C. 17. The interspaces scaled; the margin nearly truncate; A. 26; V. I, 5; P. 18. Head scaled above and on sides, except on interoperculum and muzzle. Scales ctenoid; 13—94—34. The scales are elongate and nearly truncate distally; on the sides they are in oblique series, but near the dorsal fin from three to five rows exhibit scales superposed vertically.

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* Zoögraphia Russo-Asiatica, III, p. 277.

General color pale orange, with ill-defined blackish shade on the sides, and seven quadrate blackish spots at the base of the dorsal fin; below, bright yellow. Dorsal and caudal fin yellowish at base, margins with a broad blackish band; three black spots on the middle of the first, and four on the middle of the second dorsal fin; anal yellow, with seven blackish blotches extending anteriorly across the rays; pectoral yellow, with brown spots on the rays and a black one at the base in front; eye, with five blackish radii, diverging—two anteriorly, one upward and backward, one backward, and one downward and backward. Total length, fourteen inches; length of head entering it 4.33 times; depth of body, four times in the same; eye, five times in head, 1.66 times in muzzle, and 1.25 times in interorbital width.

This fine species is more nearly allied to the *Chirus hexagrammus*, Pall. but differs in numerous respects.

CHIRUS TRIGRAMMUS. Cope, sp. nov.

Established on a specimen of four inches in length, perhaps the young of a species more like the *C. ordinatus* in size. It is related to the latter in many points. There is a supraocular dermal flap, the dorsal fins are united but a rather deep notch separates them. The scales are ctenoid, not truncate, and are oblique-rowed up to the dorsal fin; numbers, 11—107—32; counted transversely at anal fin. Lines of pores three on the body, extending to the caudal fin; a series of pores without tubes, extending along the anterior half of the base of the first dorsal, and a short line of tubules extending from below the pectoral to the gill membrane. The abdominal series unite on the median line and extend to the gill-flap membrane, as in *C. ordinatus*. Radii, Br. V; D. XXIII, 21; A. 25; P. 20. Length of head, 4.75 in total. Diameter of eye, 3.66 times in head; length, equal interorbital width. Front scaly to near nares, opercula smooth. Depth 5.5 times in length.

Color light brown to lateral line proper; below it, golden. Seven quadrate brown dorsal spots; three quadrate black spots on each dorsal fin. Sides with an open marbling of brown bands, which connect the dorsal spots with some similar ones, which alternate with them, or forming a few open meshes. Inferior and caudal fins unspotted.

This species differs from the last in the deeper division and more numerous rays of the dorsal fin, the less-developed lines of mucous tubules, and the colorless anal and other fins. It is of less interest than the two already described. The latter probably play an important part in the domestic economy of the inhabitants of the Aleutian Islands and

Alaska as food-fishes, though on this point we must look for more information.

Ammodytidæ.

This family differs from both the *Gadidæ* and *Ophidiidæ* in the *diphycercal* tail with modified hæmal spines and centra; the scapular foramen is central.

AMMODYTES ALASCANUS. Cope, sp. nov.

Depth of body one-half length of head, entering nine and three-fifths times the total length, including caudal fin. Eye one-sixth of length of head, 2.2 times in head in front of it. Head 5.5 times in total length, Mandible elongate anal, quite prominent, less than depth of body. Dorsal radii, 62; and 31; former originating above middle of pectoral. Sides with the usual oblique dermal folds, 182 in number. A single latero-ventral dermal fold on each side. End of maxillary extending to line of front margin of orbit. Br. VII.

Length, six inches; above brown; middle of sides steel-blue; below silvery.

Gadidæ.

GADUS PERISCOPUS. Cope, sp. nov.

The lower jaw a little longer than the upper, and the external teeth a little larger than the others in the latter. Vomerine teeth in a very small median patch with two larger oval patches, one on each side. Beard minute, not longer than half the diameter of the pupil of the eye. Profile of front obliquely descending from the elevated base of the dorsal fin. Eye large, 4.5 times in head, 1.5 in muzzle, and 1.2 in interorbital width. Radii, D. 13, 14, 19; A. 19, 19; ventrals with a short filamentous extremity; caudal fin a little concave. Vent below the space between the first and second dorsals. Head 4.33 times in total length; depth 5.33 times in the same. End maxillary to middle of pupil; pectoral fin to opposite last ray of first dorsal. Scales small, lateral line descending at front of second dorsal.

Length of type specimen, sixteen inches.

Color yellowish above, white below; superior fins and caudal dusky; pectoral dusky or black on the posterior face.

This cod-fish belongs to the section *Pollachius*, and is therefore quite distinct from the *G. vachna* of Pallas, of the Kamtchatkan Seas. It is also different in many respects from the *G. pygmæus* of the same author, from near Cape Saint Elias.

GADUS AURATUS. Cope, sp. nov.

Upper jaw overhanging the lower; the external teeth a little the largest. Vomerine teeth in a single patch. Beard as long as the diameter of the eye. This is one-fifth the length of the head, and enters the interorbital width one and a half times. The profile descends very gradually, for the dorsal region is not elevated. End of maxilla opposite to the middle of the pupil. Length of head, 3.6 times in the total; depth of body four and two-third times in total length. A small acumination at the upper part of the opercular bone. Radii, Br. VII; D. 18, 16, 16;

A. 19, 16. Scales larger than in the last species, smaller on the cheeks and top of head. Vent below anterior rays of second dorsal. Pectoral not quite reaching line of last ray of first dorsal. Ventrals a little produced. Caudal slightly concave.

Length of type, thirteen inches.

Sides and above, brown; lower surfaces and upper jaw, golden yellow. Superior and caudal fins, brown; the first dorsal with a median angular yellow band, which terminates at the base of the last rays in a yellow spot. Concealed surfaces of pectoral and ventral fins, dusky.

In the *Gadus rachna*, according to Pallas, the number of radii in both the last dorsal and last anal fins is greater than in *Gadus auratus;* the depth of the body and length of head are represented by Pallas as the same, while here the head greatly exceeds that dimension.

Gadopsidæ.

Günther's Catalogue of Fishes, British Museum, IV, p. 318.

In adding a new genus to this family, I call attention to the probable position of the latter in relation to others. Dr. Günther places it among the *Anacanthini*, preceding the *Lycodidæ*, while Dr. Steindachner has expressed the opinion that the genus *Gadopsis* of Richardson should be referred to the *Blenniidæ*, or near them.

On examination of the new genus *Bathymaster*, I observe that the superior pharyngeal bone do not present the type of the *Scyphobranch* division of *Percomophi*, to which the *Blenniidæ* belong, but resemble some of the *Gadidæ* in this respect. On the other hand, the large pseudobranchii are much like those of the *Blenniidæ*. The dorsal spines are so few and soft as to count for nothing, as they scarcely differ from the fissured rays which follow them. The pyloric cæca are like those of the *Gadidæ*. The structure of the scapula I cannot determine, but the basis of the caudal fin is like that of the diphycercal families. This would not, however, prevent the association of the family with the *Anacanthini* as left by Dr. Günther.

BATHYMASTER SIGNATUS. Cope, *genus et species novæ.*

Character genericus.—From elongate; a long dorsal fin well separated from caudal, which possess only four or five unbranched rays as its anterior extremity. Vent submedian, anal fin elongate, spineless, well distinguished from the caudal. Caudal rounded. Ventral fins pectoral, of one spine and five rays; scales ctenoid. Lateral line well developed, single; no isthmus; no beard of any kind. Teeth simple, in a band on the premaxillary, the outer series the largest; on the dentaries only many-rowed near the symphysis, where the inner are largest. A narrow series of vomerine and palatine teeth.

The caudal fin having become separated, I observe that it is supported by the usual modified hæmapophyses with aborted centra, and is not isocercal as in the *Anacanthini* generally.

Pyloric appendages in small number. Branchial arches four, with a fissure behind the fourth; a large pseudobranchus.

The characters which separate this genus from *Gadopsis* are many. The pectoral ventrals with five rays and the large pseudobranchiæ are among the most marked. In the former point it is less, in the latter more like the *Blenniidæ*; on the side of the *Anacanthini* its form is most like that of *Brosmophycis*, Gill, which, however, has the ventrals much reduced.

Lateral line not flexed nor interrupted, dorso-lateral. Eye large.

Character specificus.—Body gradually contracting from the anterior part of dorsal fin. Head broad, but narrowed above; muzzle descending rather abruptly. Eye very large, equal length of muzzle, 3.66 times in length of head to apex of bony operculum, beyond which extends a considerable dermal flap. Length of head four times in the total, exclusive of caudal fin. Depth 5.1 in the same. Dorsal and anal fins not very elevated, the rays of both about 1.5 times the length of the eye's diameter. Radii, Br. VI; D. 47; A. 34; P. 20, the inferior rays much subdivided distally. Lateral line following dorsal outline; numerous lines of mucous pores with short tubules on the head. Scales, 9—101—30. A band from the top of the head to the first dorsal ray naked; jugular region scaled. The dorsal fin originates above the *bony* angle of the operculum much in advance of the basis of the pectoral, while the origin of the ventrals marks a point between the two. Four pyloric cæca. Total length, twelve inches. Color, a dark leather-brown everywhere, with some purple reflections on the head. Anal fin, dark purplish. A deep black spot crossing the extremities of the webs and first five spines of the dorsal fin. Extremities of the lower pectoral rays blackish.

From near Sitka, Alaska.

The large eye of this species renders it probable that it inhabits considerable depths of the ocean. The discovery of this species, due to Mr. Davidson, is the most important result of his investigation in this field, bringing to light, as it does, a *high* northern representative of a form supposed hitherto to be confined to the fresh waters of Tasmania and Australia.

Pleuronectidæ.

PLEURONECTES PERARCUATUS. Cope.

Teeth obtusely conical. Lateral line strongly curved in front, the width of the arch nearly half its length and nearly twice the width of the basis of the pectoral fin. Scales ciliated, not spiny, 91 on the lateral line; head scaly. Front between orbits very narrow, keeled. Inferior orbit a very little in advance, 4.66 times in head, a little larger than the muzzle. A short lateral line along the basis of the dorsal fin, its posterior terminus opposite the origin of the real lateral line. Under jaw longer than upper, maxillary reaching to anterior line of orbit. Length of head 3.5 times in length without caudal fin, depth of body 4-9ths of the same. Radii, D. 74; A. 59–60. Length, six inches.

Color, reddish-brown, unspotted. Fins, dusky; a series of rather large, very faint spots on the dorsal fin.

This flat-fish belongs to the group *Platichthys* of Girard. It is near his *P. umbrosus*, but has more anal radii and scales, a more strongly curved lateral line, and lacks the interorbital tubercles, &c.

Stated Meeting, February 7th, 1873.

Present, 16 members.

Vice-President, Prof. CRESSON, in the Chair.

Letters accepting membership were received from Dr. W. Pemberton, dated Philadelphia, Jan. 21; Mr. Frazer, dated Camden, Jan. 22; Mr. A. H. Spofford, dated Washington, D. C., Jan. 27; Mr. Rothermel, dated Philadelphia, Jan. 27, 1873.

A Photograph of the late Mr. Eckfeldt was presented for insertion in the Album.

A letter acknowledging the receipt of a long-delayed diploma of membership was received from Mr. Prestwich, dated Shoreham, near Seven Oakes, England, Jan. 11th, 1873.

Letters acknowledging the receipt of A. P. S. publications were received from Prof. Hyrtl, Nov. 1, 1872 (85); the Prague Observatory, Sept. 2, 1872 (86); the Lyons Agricultural Society, Sept. 20, 1872 (73–85, desiring, in addition, 1–72). On motion, the Librarian was authorized to furnish the A. and N. H. Society with Nos. 1–72 so far as the stock permits.

No. 89 of the Proceedings was laid on the table.

Donations for the Library were reported from the St. Petersburg, Prague, and Radcliffe Observatories, the Academies at Berlin and Philadelphia, the Societies at Marburg. Dresden, and Lyons, the Geographical Societies at Paris and London, the Anthropological Society at Paris, the R. Astronomical Society at London, London Nature, Revue Politique, Journal of Applied Sciences, Silliman's Journal, Cornell Era, Medical News, Journal of Pharmacy, U. S. Pharmacopœia, Penn Monthly, New York State Library, Prof. O. C. Marsh, Dr. Jos. Carson, Dr. Rushenberger, the Franklin Institute, U. S. Chief of Engineers, Wisconsin Historical Society, and Mr. Jos. A. Gebow, of Green River City, Wyoming Territory.

The decease of the Rev. Adam Sedgwick, at Cambridge, England, Jan. 28, aged 88, was announced by the Secretary.

The decease of M. F. A. Pouchet, at Rouen, Dec. 6th, 1872, aged 74, was announced by the Secretary.

The decease of Mr. Joshua Francis Fisher, at Philadelphia, January 21st, 1873, aged 68, was announced by Mr. Cresson.

Prof. Cope communicated a note on two new Perissodactyles, from Wyoming Territory.

Dr. Horn communicated a paper on the Classification of Coleoptera, by G. R. Crotch, M.A.

Prof. Chase communicated some newly-observed mathematical relationships between the orbits of the planets.

Dr. Cresson exhibited a graduated condenser for the spectroscope, in which the condensation surface is enlarged or diminished gradually and easily, instead of in large increments or decrements.

Dr. Allen described some of the results of his investigations into the fundamental types of Aztec and other pictorial writing, and followed the type forms in their course through various and curious modifications, resulting in otherwise unintelligible figures. He illustrated the process of change by the Crotaloid curve (rattlesnake mouth), the rattlesnake rattle, the full-face and profile human skull, the human figure, &c., reduced in one direction to their simplest linear elements, and in the other developed into bizarre combinations.

Dr. Goodwin spoke of the value of such researches, in which the principles of organic change, studied by comparative zoologists, are applied to the morphology of literature.

Dr. Brinton added his testimony to the novelty and importance of Dr. Allen's researches, and gave instances to illustrate both its necessity and its difficulty. He believed that Dr. Allen had discovered the true method of explaining the American picture-writing.

The meeting was then adjourned.

ON THE NEW PERISSODACTYLES FROM THE BRIDGER EOCENE.

By Edward D. Cope.

(*Read before the American Philosophical Society, Feb.* 7, 1873.)

LIMNOHYUS LÆVIDENS. Cope.

This species is one of the larger forms of the group originally represented by *Palæosyops*, and which has turned out to be so numerous in species. Thanks to the labors of Prof. Marsh, these have been placed on a recognizable footing, and I have been enabled to distinguish not only the species he has described but a few others in the collections obtained by Dr. Hayden's expedition of 1872.

The present species is chiefly represented by a nearly complete cranium with dentition, from Bitter Creek, and a cranium lacking the posterior part of one side and the lower jaw, from Cottonwood Creek. The molars have the general form of those of *L. robustus*, but the second superior premolar has but one outer tubercle. The cingula are much less developed than in that species; those between the inner cones of the molars being entirely absent. These cones are low, and with the rest of the crowns of all the teeth, covered with smooth and shining enamel. The anterior median small tubercle of the first true molar is wanting. The last true molar has but one interior cone.

The canine tooth is powerful and bear-like; the outer incisor is the largest. The premaxillary bones are short, and the side of the face elevated and plane to the convex nasal bones. Zygomatic arch massive.

	M.
Length molar series (No.1)	0.140
" true molars	.085
" three incisors	.034
" crown canine	.030
" " last molar	.039
Width " " "	.036
Length cranium to occipital crest	.345
" true molars (No. 2)	.101
" last " " (oblique)	.039
Width " " " (transverse)	.038

The measurements of this species are intermediate between those of *Palæosyops paludosus* and *P. major*, of Leidy; those of the latter agreeing with the *Lymnohyus robustus*, Marsh, and perhaps other species.

PALÆOSYOPS FONTINALIS. Cope.

A small species agreeing with the *P. paludosus* in the two interior cones of the last superior molar. It is represented especially by a considerable part of the cranium of an individual in which the last superior molar is not quite protruded, but with the other molars and last premolar of the permanent dentition in place. The enamel of these teeth is in accordance with the age, delicately rugose, and while the cingulum is present fore and aft, it is wanting internally and externally. The anterior median tubercle is present on all the true molars, and the bases of the acute inner cones are in contact. The sagittal crest is truncate, and the squamosal portion of the zygoma very stout. The nasal bones are together very convex in transverse section.

	M.
Length of true molar series (2.75 in.)	0.067
" last "	.025
Width " "	.026
Length of penultimate molar	.026
" " "	.026
Depth squamosal process	.025

Found by the writer on a bluff on Green River, near the mouth of the Big Sandy, Wyoming.

I have just received a paper "On the Gigantic Fossil Mammals of the Order Dinocerata, by Prof. O. C Marsh," which contains a formidable catalogue of errors which the author appears to suppose I have committed in describing animals of this type. All this is explained by the fact that Prof. Marsh has never seen the genus *Eobasileus* Cope, and erroneously supposes it to resemble *Uintatherium* Leidy (*Dinoceras* Marsh). The descriptions which I have given are correct, as will presently appear, as well as the fact that I have anticipated the Professor in the descriptions of some of the allied species.

Stated Meeting, February 21st, 1873.

Present, 14 members.

Vice-President, Prof. Cresson, in the Chair.

Letters of acknowledgment were received from the N. H. Union at Bonn, Aug. 6th (84, 85, 86); Bureau des Longitudes, Jan. 7th (89, XIV, iii); the Historical Societies of Maine, New Jersey, Maryland and Georgia (89); the Essex Institute, Feb. 14th (89); Lyceum N. H. N., York, Feb. 10th (89).

A letter of envoy was received from the Census Office, Feb. 11th, 1873.

A letter from Mr. A. Van Name, Lib. Yale College, was read, requesting deficiencies to be supplied.

Donations for the Library were received from the R. Prussian and Belgian Academies, Netherland Botanical

Association at Nijmegen, Geographical Society at Paris, Revue Politique, London Nature, R. Astronomical Society and Meteorological Office, Boston Public Library, Prof. Horsford, City of Boston, American Antiquarian Society, Cornell University, Franklin Institute, American Pharmaceutical Association, House of Refuge and Water Commissioners, Offices of the U. S. Army and Census, Congressional Library, U. S. Naval Observatory, and Mr. E. K. Price.

The Committee on the Chess Knights' Tours was, on motion, discharged from further consideration of the subject.

Dr. Horn communicated papers on the "Revision of the Species and Genera of the tribe Hydrobiini of the United States," and "Revision of the Species of several Genera of Meloidæ of the United States."

Prof. Cope exhibited the remains of a gigantic Proboscidian (Eobasileus) from Wyoming, and offered for publication in the Proceedings remarks on the Short-footed Ungulates of the Eocene of Wyoming.

Mr. Blodget read a paper on the Unperiodic Distribution of Heat, suggesting the possibility of a Cosmical cause for the exceptionally severe accesses of heat and cold in American districts.

Mr. Lesley considered it needless to look beyond the recognised phenomena of radiant heat through a dry atmosphere, in connection with the perpetual presence of Arctic cold a few thousand feet above the surface of the earth, in seeking for the true explanation of "Texan Northers" and other locally excessive cold spells.

Dr. Horn gave his experience in Orme's Valley, California, where the dryness of the air sometimes made a difference of 75° (seventy-five) F. between the wet and dry bulbs. On such occasions the nights were always extra cold.

After further discussion by Prof. Chase, the Minutes of the last meeting of the Board of Officers were read.

New nominations Nos. 715 to 728 were read; and the meeting was adjourned.

ON THE SHORT FOOTED UNGULATA OF THE EOCENE OF WYOMING.

BY EDWARD D. COPE.

(Read before the American Philosophical Society, Feb. 21st, 1873.)

In no group of *Mammalia* have the determinations of palæontology been more significant than in the *Ungulata*. Here, in an especial manner, the anticipations of science have been realized, in the filling up of the numerous gaps in the series of living forms. Here especially is it evident, that the existing fauna is but a fragment, and that the faunæ of the past, as we know them to-day, are but the precursors of what we may bring to light to-morrow.

The primary range of variation in the structure of the *Ungulata*, has been generally admitted by zoölogists to be found in the structure of the limbs and feet. Three most prominent types have been distinguished on this basis, viz.: the *Artiodactyla*, *Perissodactyla* and the *Proboscidia*: with some of the lesser importance, those of the *Toxodontia* and *Hyracoidea*.* If we direct our attention to the detailed structure of the feet, or of the teeth, each division offers its own range of variation; witness in the *Artiodactyles* the differences between the *Ruminantia* and *Omnivora*, and in *Perissodactyla*, between *Equus* and *Rhinocerus*. In either order canines and incisors may be present or absent, and molars assume a great variety of patterns of enamel plication. The toes in the latter order may vary from four to one. Nevertheless, the most diverse genera are bound together by intermediate forms, often extinct. Connecting *Omnivora* and *Ruminantia* come *Oreodon*, *Merycopotamus*, *Tragulus*, *etc.* In *Perissodactyla*, *Anchitherium*, *Palæosyops*, *etc.*, connect the extremes.

The Proboscidians have, on the other hand, remained until recently an isolated group with but few representatives, hence its definition as an order, has been more or less obscured by characters of a special nature, drawn from the dentition, trunk, etc., which it has been found necessary to omit in characterizing the two orders above mentioned. These characters are so striking in their appearance as to suggest greater systematic importance than belongs to them. Thus the trunk is not more important as a character of the *Proboscidia*, than it is of the *Perissodactyla*, where the tapir alone possesses it. Nor are the complex molars and large tusks to be regarded as a definition, for in the *Phacochœrus* we have molars as compound as in some mastodons, huge canine teeth and no incisors below; characters very different from many Artiodactyles. Nor can we regard the exclusive union of the astragalus with the navicular as a final test, for in Perissodactyles the facet for union with the cuboid may be considerable (*Rhinocerus*) to almost nothing (*Equus*).

The occasion for this discussion is presented by the discovery by the palæontologists of Hayden's geological surveys of 1871-2, of the remarkable types *Bathmodon*, *Uintatherium*, and *Eobasileus*. These genera contradict in several particulars the characters usually assigned to the *Proboscidia*, while they agree with them in others, and they thus present the problem of classification, which will ever recur so long as additions to our knowledge of the life of the past continue to be made. This problem is simply the question as to what characters shall be retained as definitive of natural divisions, on the discovery of intermediate forms. As our system is an expression of the possession of structural characters, our higher groups or orders are naturally expressions of the existence of the more comprehensive characters, or those present through the most extended series of species. Hence we believe them to be also those assumed earliest in time.

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* *Vide* Gill, Arrangement of the Families of Mammals, Smithson, Misc., Coll., 1872, No. 230; the best analysis of the *Mammalia* yet published.

In the case of the *Ungulata*, the structure of the feet seems to define the greatest range of the species. Thus the *Artiodactyla* and *Perissodactyla* are digitigrade or unguligrade, while the *Proboscidia* are nearly plantigrade. The first order exhibits the equal development of the third and fourth toes; the second of the third toe, while in the *Proboscidia* the structure is like the last, with more numerous digits. But this order differs from both the preceding in the relations of the ulna and radius. In *Artiodactyla* and *Perissodactyla* the ulna diminishes greatly distally and presents but a small carpal articular surface obliquely behind that of the much larger radius. In *Proboscidia* the ulna presents the larger articulation with the carpus, and the radius crosses it obliquely, and presents its articular face alongside of the ulnar.

The characters of the three orders may be thus stated:

PROBOSCIDIA.*

Feet plantigrade but elevated behind by a plantar pad. Toes numerous, short, the middle (3d) largest. Hind limb with knee free from the body; tibia without spine; astragalus flat, not produced anteriorly. Fore limb with well developed ulna articulating extensively with the carpus along side of the smaller radius, which crosses it obliquely.

PERISSODACTYLA.

Feet digitigrade, with a hock joint. Toes reduced in number, the third largest. Hind limb with knee enclosed in integument of body; femur with third trochanter; tibia with spine. Astragalus with pulley-shaped articular face for tibia and anterior prolongation. Fore limb with ulna reduced, its carpal surface smaller than that of the radius, which supports the foot in front of the ulna.

ARTIODACTYLA.

Feet digitigrade or unguligrade. Toes reduced, the third and fourth principally and equally developed. Hind limb with knee applied to the side of the body, and elevated hock; femur without third trochanter;

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* These characters have been mostly given by Prof. Gill, l. c.

tibia with large spine. Astragalus with both inferior and anterior pulley-shaped surfaces. Ulna much reduced distally, behind the radius, which includes almost the whole of the carpal articulation.

This arrangement violates previous views less than any other that would recognize the primary characters of the *Eobasileus*. The difficulty of determining the limits of the two first named orders, is partially caused by the fact that the *Hyracoidea* present the radius of the *Proboscidia* with the hind foot of the *Perissodactyla*. These animals are, however, well regarded as a distinct order. Whether all the animals to be included in the *Proboscidia* possessed a proboscis or not, is of secondary importance. It is nevertheless highly probable that *Loxolophodon* and *Eobasileus* possessed one, and not unlikely that such forms that approach still nearer the tapirs were not without an organ such as they possess, and which Cuvier ascribed to the *Palæotheria* and other allies.

The divisions of the *Proboscidia* are as follows:

No incisors, nasal bones short; astragalus articulating with navicular only: No third trochanter...............	*Proboscidia vera.*
No incisors, nasal bones elongate; astragalus articulating with both navicular and cuboid: No third trochanter..	*Dinocerata.*
Dentition complete; *i. e.* incisors present; ? nasal bones. Astragalus articulating with both navicular and cuboid: A rudimental third trochanter............	*Pantodonta.*

These suborders present a series of approaches to the *Perissodactyla.* Thus the *Dinocerata* agree with the typical *Proboscidia* in addition to the above points, in the posterior expansion of the scapula, and its apical acumination; in the very short cervical vertebræ; in the flat carpal bones; in the absence of pit for round ligament of the femur; in the flattened great trochanter, contracted condyles, and fissure-like intercondylar fossa of the same bone. In the longitudinal crest of the tibia separating glenoid articular faces which are on a transverse line. In the short calcaneum which is wider than long, and tubercular on the inferior face. In the five digits; the acetabulum not separated by a peduncle from the iliac plates, and the lack of angular production of the latter beyond the sacrum. Also in the three distinguished sacral vertebræ, as contrasted with the five closely coössified ones of the *Rhinocerotidæ.* These characters are, some of them, of subordinate value only.

The chief differences are seen in the cranium, though here also there are important resemblances. Thus in *Loxolophodon* the malar bone forms the middle element of the zygomatic arch, sending a narrow strip only forward to the neighborhood of the lachrymal. In *Uintatherium*, according to Marsh, its extension towards the side of the face is rather greater, but still much less than in Perissodactyla. The dentition is not far removed from that of *Dinotherium*, and the mode of succession of the teeth was in all probability similar. The premaxillaries and nasals are excavated and exostosed for the attachment of a trunk in *Loxolophodon*. The lateral and occipital crests of the cranium, though different from the enlarged sinuses of the diploe of Elephants, represent the external walls of this structure, and furnish a hint as to its mode of origin, and serve to ease the transition to Perissodactyles.

The differences in the cranium are consequent upon its anterior elongation, the nasal bones and premaxillaries becoming thus much extended. The lachrymal is perforated by a small lachrymal canal in *Uintatherium*, according to Marsh, but excavated on the margin only in *Loxolophodon*. It is neither in *Elephas*. There is a postglenoid process more largely developed than in *Proboscidia vera*. Other differences of still less importance are to be seen in the anterior position of the exterior nares, and the presence of horns.

The *Pantodonta* are represented by *Bathmodon*. With a structure of the hinder limb nearly resembling *Eobasileus*, we have more pronounced relationships to the Perissodactyles. The scapula has the massive apical acumination of the *Proboscidia vera*, and there is no round ligament of the femur in some of them. The astragalus has the same flattened form seen in *Uintatherium* and is even less like that of the Perissodactyla. The type of molars and the long compressed canines are similar to those of *Loxolophodon*. On the other hand, the cervical vertebræ are rather longer, and there is a rudimental third trochanter of the femur.

History, etc. I originally referred the *Eobasileidæ* to the *Proboscidia*, on account of the structure of the limbs, and subsequently stated a number of reasons for this conclusion at a meeting of the Academy Natural Sciences of Philadelphia, held January 14th, 1873 (published January 16th). In the present paper, numerous confirmatory characters are added. The *Bathmodontidæ* I have heretofore referred to the *Perissodactyla*.

Prof. Marsh, in describing a species of this group, *Titanotherium ? anceps* (July, 1871), compares it with perissodactyle species, and in describing the tibia says, that it "at its proximal end, has the femoral surfaces contiguous, with no prominent elevation between them, resembling in this respect some of the Proboscidea." A few days before the publication of my conclusions, in a foot-note (July 22d, 1872), he altered the name *Titanotherium* to *Mastodon*, indicating that he had reached the same opinion. Shortly after (Amer. Journ. Sci. Arts, Sept. 27th), he altered his view, constructing a supposed new order "*Dinocerata*," for their reception.

As regards the name of the order here defined as including the three suborders above mentioned, I have preferred using one already employed to coining a new one. This is the better course also, if, as is not unlikely, the distinctions on which it, as well as the other two orders repose, shall be broken down by new discoveries in palæontology.

DINOCERATA.

The genera of this group known to the writer are four, which differ as follow:

1. Nasal bones with flat horizontal horn-cores overhanging their apex.
Cervical vertebræ short; malar bone much reduced in front...*Loxolophodon.*
2. Nasal bones with small tuberosities.
Cervical vertebræ short...*Eobasileus.*
Cervical vertebræ longer; the malar bone reaching maxillary face...*Uintatherium.*
3. Nasal bones without the anterior horn-cores.
Cervicals?..*Megaceratops.*

The dentition of this group requires special notice. Judging from the relative sizes of the teeth, I have written the molar series of *Loxolophodon* 4—2, but judging from the forms of the crowns, it should be 1—5. However this should be, I have no doubt that as in other *Proboscidia* the premolar and not the molar series is deficient, and that there are three or four true molars at least. In a mandible found alone, which agrees in size with some species of *Uintatherium*, six molars are preserved. Of these the posterior two display three sub-transverse crests, of which the anterior two form a chevron with open apex directed to the inside. Anterior to the front crest is a cingular tubercle. The symphyseal part of the jaw is remarkable: it is coössified, exceedingly compressed, and curved upwards so as to resemble slightly the narrow prow of a South Sea boat. There are two teeth on each side, which are separated from the molars by a diastema. They are much compressed and curved upwards and forwards, and the anterior pair issue from the jaw in contact. The crowns are lost in the specimen. The determination of these teeth is facilitated by the presence of the mental foramen below the posterior one. This foramen issues, as is well known, posterior to the canines in all *mammalia*, and either below premolars, or the diastema. The two teeth in our fossil will then be premolar and canine respectively, and the incisors must be regarded as wanting. This is in conformity with the structure of the upper jaw, and is rendered probable by the great reduction of the symphysis of the lower jaw in the species. It is also suggested by the almost universal tendency to reduction of the incisors seen in the mammals of the same extinct fauna. In *Bathmodon* and *Palæosyops* the canines are thrown into the incisor series as in *Ruminantia*, and in *Palæosyops* the outer incisors are much reduced. In several genera there are but two incisors. Finally in *Synoplotherium*, and probably in *Anchiphodus*, the large inferior teeth described by Dr. Leidy and myself as incisors and which resemble the cutters of *Rodentia*, are immediately in front of the mental foramen, and bear the same relation to it and to the premolar teeth, as do the canines of *Palæosyops* and other mammalia. Hence I believe these to be canines, and that the inferior incisors are wanting. The probability of the truth of this determination is increased by the presence of a small interval between them, and by the fact that they oppose the canines of the upper jaw.

LOXOLOPHODON. Cope.

Proceedings American Philosophical Society, 1872, p. 580, extra copies published August 19th; and p. 488 (Aug. 22d).

The cranium in this genus is very elongate and compressed. The muzzle is posteriorly roof-shaped, but is anteriorly concave and flattened out into a bi-lobed shovel which rises above the extremity of the bone. This extremity is subconic, and short and decurved. A second pair of horn-cores stands above the orbits; each one composed externally of the maxillary bone, and internally of an upward extension of the posterior part of the nasal. Behind this horn the superior margin of the temporal fossa sinks, but rises again at its posterior portion, probably above the level of the middle of the parietal bones. This portion of the skull is injured in my only specimen. The occipital rises in a wall upwards from the foramen magnum, and supports, probably a little in front of the junction with the superior and inferior ridges bounding the temporal fossa, a third horn core on each side. The base of this core is as stout as that above the orbit, and sub-cylindric in section. The temporal fossa has its principal extent posterior to the zygomatic arch, and is in form like a trough, the inferior edge being recurved from the squamosal process to the summit of the occipital crest. It is narrow within the zygomatic arch, which is short, enclosing a space whose length is less than one-fourth that of the cranium.

The occipital bone extends but a short distance on each side of the condyles, and is separated from the mastoid by an irregular suture, which is pierced by a large mastoid foramen. On the inferior face near to each condyle and one-third the distance from its inner extremity, is a posterior condyloid foramen, isolated by a narrow bar from the extremity of the *foramen lacerum posterius*. The paramastoid process is represented by a small tuberosity, and the mastoid by a rather larger one, some distance anterior to it.

The *meatus auditorius* opens upwards just below the external ridge of the temporal fossa and at a little distance behind the post-glenoid process. Its canal contracts rapidly, and extends upwards and backwards towards the labyrinth. It is separated from the *foramen lacerum* by but a thin wall, and if there was an expansion of the *cavum tympani*, it must have been exceedingly small, owing to the close approximation of the mastoid to the basi-occipital and sphenoid at this point. The labyrinth is lodged in a petrous mass opposite the occipito-mastoid suture, and the canals are small.

The *basi-occipital* contracts anteriorly, and with the sphenoid forms an uninterrupted boundary of the *foramen lacerum*. This terminates opposite to the posterior boundary of the external meatus, and gives rise to a wide shallow groove which extends anteriorly between the pterygoid ala and the postglenoid process, and turning outwards round the latter, grooves it. Opposite to the postglenoid process and just posterior to the end of the pterygoid a small foramen enters, which is probably the *foramen ovale.* Almost continuous with it is a canal which pierces the base of the pterygoid longitudinally, and issues in an excavation of its external face near the sphenoid.

The *pterygoids* are remarkable for their great length, enclosing as they do with the palatine processes, a deep, narrow, trench-like fossa, which measures almost the entire length of the zygomatic fossa. Processes of the sphenoid contribute to these walls (which are thus double), and the sphenoid roof is strongly concave. The *alisphenoid* is elongate antero-posteriorly, and is principally in contact superiorly with the frontal; anteriorly it has a short suture with the lachrymal. Almost its entire length is traversed by a shallow groove which terminates in a small *foramen opticum,* opposite to a point marking the posterior third of the zygomatic fossa. The *foramen rotundum* issues as usual between the alisphenoid and the pterygoid, but is considerably anterior, as well as inferior to the *f. opticum.* I cannot determine whether the orbitosphenoid is distinct.

The *lachrymal* is a large bone of a triangular outline, the shorter side being inferior. It is entirely on the inner face of the orbit, and as in the elephant, separates the frontal and maxillary by its superior prolongation. Its inferior border is slightly notched in front by the large *foramen infraorbitale posterius,* and the anterior is deeply emarginate, passing behind the small *f. lachrymale.*

The palate is remarkable for its length and narrowness. Its roof is chiefly composed of the maxillaries, but a very short portion is formed by the palatine plates of the *o. o. palatina.* These are produced into a median point behind between the nares, and exteriorly form the inner wall of the postnareal trough for a considerable distance. The *maxillaries* also form the outer wall for a short distance, being produced in a contracted form behind the molar teeth. The two bones enclose a small foramen in this prolongation, and a larger one on the anterior suture of the palatine, the *foramen palatinum.* The palate is deeply concave anteriorly. There is an elongate foramen close to the alveolus of the first premolar, extending anterior to it. The premaxillaries are longitudinal and separated anteriorly for two-fifths of their length, by a large *foramen incisivum,* which they do not enclose. They extend on the side of the muzzle into an acute angle upwards and backwards and are prolonged forwards above the exterior nares, which the suture reaches by an abrupt descent. The maxillary supports the malar on a posteriorly directed process which reaches to the end of the anterior third of the arch below, half that distance on the side, and is bordered by a narrow strip of the malar on the inner side, as far as the anterior boundary of the orbit. The *premaxillaries* do not enclose the very large *foramen incisivum* in front, and are therefore deeply furcate.

The *dentition* is I. 0; C. 1; P. M. 4; M. 2. The canine is a tusk of compressed form with anterior and posterior cutting edges, and a strong posterior curvature. Its fang is embraced one-third by the premaxillary bone, and is enclosed in a rib-like swelling of the side of the cranium, which extends upwards and backwards. The premolars are well worn, and have transverse cordate surfaces of attrition. These have probably resulted from the wearing down of a chevron of two crests converging inwards, in some with an inner tubercle. On the molars this crescent is represented by a V, with the apex inwards; on the last, the inner tubercle is at one side (the posterior) of the apex.

Name.—I first applied the name *Loxolophodon* to this genus in a short paper published August 19, 1872, as above cited, with a diagnostic description; the *L. cornutus* was there cited as the first species, and is here retained as the type. I again described it more fully in a paper published August 22d, citing *Eobasileus* (August 20th) as a synonym, in which I was in error, as indicated by the present paper. The same nomenclature was employed in a paper read before the American Association for the Advancement of Science, held at Dubuque, commencing August 23, 1872.

In the paper of August 22d, I regarded this genus as identical with that to which I had previously (February 16, 1872) applied the name *Loxolophodon*, and included in it the species there called *Bathmodon* (*Loxolophodon*) *semicinctus*, Cope. With further material this appears not to be correct; the *Bathmodon semicinctus* belongs truly to that genus, and is very near to the *B. radians*, so that the name *Loxolophodon* becomes a synonym in this connection, and may be used again for the present genus without interference.

LOXOLOPHODON CORNUTUS. Cope.

Loxolophodon cornutus, Cope. Proceedings American Philosophical Society, 1872, p. 580 (August 19th), l. c. 1872, p. 488 (August 22d). *Eobasileus cornutus*, Cope, American Naturalist, 1872, p. 774.

Established on the remains of a single individual, which consist of a nearly perfect cranium, the right scapula complete, several vertebræ including the sacral, the first or second rib, the pelvis complete, and the entire right femur; also probably the proximal end of a radius.

The species is remarkable for the narrow form of the *cranium*, its width at the middle being one-fourth its length. A little in front of the middle, are situated the horn-cores. These diverge, the upper portion having an outward curvature. The base of each is triangular with obtuse angles in section, and the inner angle is the section of a rib-like projection which extends across the middle line to its fellow and rises half way up the horn-core. Above its rather abrupt termination, the core is transversely compressed, with oval obtuse apex. The core measures M. .240 (9.5 inches) from its base in front, M. .108 (4.25 inches) in width at the base behind, and .077 (3 inches) in diameter at the apex. A slight swelling of the sides of the muzzle descends obliquely forwards from the base of each horn, which enlarges below into a prominent rib, which encloses the alveolus of the canine tusk. In front of the horns the muzzle is roof-like; anteriorly it flattens out, and swells a little above the posterior end of the nasal meatus. In front of this it expands again, and rises gently to the extremity of the bi-lobed nasal shovel, which overhangs the premaxillaries, the nasal meatus and the greater part of the apex of the nasal bones. The latter is short and with a wide base and resembles two lateral cones flattened together, their extremities obliquely truncate outwards and excavated. The composition of the upper surface of the cranium is somewhat difficult to determine, owing to the injured state of the posterior part. If we regard the bone which bounds the lachrymal behind and above, as frontal, as I did in originally describing the species, it gives an extraordinary extent to the nasals, for the common suture of these bones extends V-shaped backwards, to a point opposite to the middle of the zygomatic arches. It gives to the nasals an extent equal to that of the frontals and parietals combined. They not only support the anterior shovels but form the inner half of the median horn-cores, rising as high as the tuberosity above described. To regard these bones as frontals would involve the improbable peculiarity of their extending beyond the nareal orifices, and the terminal cone of the nasals is not separated from them by suture. The question is decided in favor of their being nasals, by those bones as preserved in *Eobasileus pressicornis*, Cope, where the shovel is represented by a tubercle only on the side of a continuous nasal. The immense length of the snout in *Loxolophon* looks as though the nasal bones had extended themselves forward, so as to ossify the basal portions of an elephantine proboscis.

The frontals descend behind the horns, with a very obtuse or rounded continuation, to the inner side of the fossa, and without any superciliary margin. They form with the posterior part of the nasals a shallow median basin. The suture with the parietals is very indistinct, but if I have truly discovered it, it forms another posteriorly directed chevron, and leaves but a narrow superciliary portion of the frontals. Above the postglenoid processes the parietals rise again to the transverse occipital crest, but to what height is uncertain. At the mastoid region, the cranium widens a little, and is excavated at the sides by the temporal fossæ. Near where the lateral and posterior crests join the inferior ridge-like border of the temporal fossa, in front of a position occupied by a knob in *E. pressicornis*, is a strong horn-core with sub-cylindric base. It stands obliquely backwards towards the junction of the inferior squamosal and transverse crests, and is connected to these by an oblique ridge, one side of which is marked with irregular, short, longitudinal rugosities. At the base of these elevations are three sinuses. This portion was found close to the skull, but separated from it, and the precise mode of its attachment has not been discovered by actual fit.

The occiput rises upwards for four inches above the condyles; perhaps it displayed a posteriorly sloping transverse crest as in *E. pressicornis*.

The paramastoid and mastoid tuberosities are narrowed and extend obliquely downwards and forwards. The lower part of the exoccipital suture runs along a ridge, and there is a tuberosity in front of the mastoid foramen. An irregular Λ-shaped crest extends upwards with the apex at the inferior temporal crest, and its anterior limb forming part of the posterior boundary of the *meatus auditorius*. The inferior temporal crest is directed outwards below, but forwards above.

The narrowness of the cranium is readily seen on comparing the postglenoid processes. These are not deep, but have considerable transverse extent, and are separated by a space only a little greater than the transverse diameter of each. The zygomatic arches are compressed posteriorly with crest-like superior ridge, but rounded above anteriorly. There is not the least trace of posterior boundary of the orbit. The squamosal process overlaps the malar bone extensively, terminating in a point, the latter ending obtusely. The malar is supported in front by a maxillary process, which is united with it by a zigzag suture on the outer face and a squamosal one within and below. The *foramen infraorbitale exterius* is large, and issues a short distance in front of the orbit, not so near it as in the elephants. From this point to the ridge enclosing the canine alveolus the side of the maxillary bone is deeply concave, and the palatal surface correspondingly contracted. The bone is continued upwards and outwards as the external part and apex of the middle horn-cores. Anteriorly it is bounded by the premaxillary to a point as far anterior to the base of the horn as the width of the latter; behind that point it is in contact with the nasals. The premaxillary is prolonged upwards and backwards into a narrow tongue. Its inferior portion is convex above on each side, concave below, with projecting alveolar borders, which are flat and slightly concave fore and aft. The extremity of each is rugose below, supports a prominent tubercle medially and a smaller one at the superior angle.

The exterior nares are not separated by osseous septum. Their lateral border is marked on the inferior surface of the nasal and premaxillary roof, by a curved ridge or crest, which converge forwards and bound the interior concavity of the roof. They gave support to muscular or ligamentous attachments. The posterior angle of the nares is abruptly excavated with thickened walls. The palate is remarkably narrow, and is most deeply excavated between the alveolæ of the tusks, or at the maxillo-premaxillary suture. From near this point to the palatine suture a low but sharp crest extends along the middle line. The width of the palate at the diastema is one ninth of its length. The diastema is more than half the length of the molar series. The pterygoid process of the palate has two convergent grooves on its inferior surface.

The *teeth* are remarkable for the extent of the exposure of their slender roots, as well as their very small size as compared with the size of the animal. The tusk is slightly turned outwards at the tip and the inner face is worn by attrition with some opposing tooth for one-third its length on the posterior third. The superior margin of the enamel on this side is chevron-shaped, the apex being only one-third the length from the extremity. It extends further upwards in front and on the outer side, but is worn in an oval patch at the apex of the chevron of this side by contact with the inferior teeth, as above described. The enamel is smooth behind, rugose in front. The apex contracts regularly to a flattened obtuse point. The fang is hollow for about half its length. The enamel of the molars is nearly smooth. Each one has a strong cingulum fore and aft, which is discontinued on the inner and outer faces except in P. M. 1, and M. 2. In the former, it is continued on the outer side at the base of the concavity of the exterior face; on the latter, it is continued round the inner side. The grinding surface of the P. M. 1, is tripodal, and probably composed of a worn crescent and inner tubercle. The others are transverse arrow-shaped; the P. M. 4 is much more worn than the others. M. 2 is larger than M. 1. Its oblique crests have evidently been worn from before. All the molars have three roots, but the posterior pair are united for part of their length in all.

The *vomer* does not unite with the superior crest of the palatine bones. The sphenoid flattens out behind the post-nareal trough and is coössified with the basioccipital. The latter is marked by two oval surfaces at the place of suture, with a slight prominence between. No lower jaw was found with this specimen, but from the contraction of the parts opposed to it, it was evidently very small.

Cranial Measurements.

	M.
Length from end nasals to end occipital condyle (3 feet 1.5 inches)	0.930
Width just behind end nasal shovels	.192
" in front of horns	.132
" at base of horns in front	.205
" behind horns at apex of frontal suture	.185
" above posterior edge *meatus auditorius*	.310
" between apices horn-cores	.370
" basis supraoccipital horn-core	.100
" including zygomatic arches (greatest)	.320
Length of nasal bones to ridge between horn-cores	.410
" " " " " frontal suture	.540
" of zygomatic fossa above	.230
" from angle nares to end shovel	.205
" " " " " " premaxillary	.155
" from end premaxillary to basis of canine	.120
" " " " " " P. M. 1	.276
" of molar series	.185
" of palate	.450
" of pterygo-palatine crest	.200
" of sphenoid axis	.185
" " basioccipital (with condyles)	.128

	M.
Width between tips premaxillaries	.070
“ at canine alveoli	.185
“ between canine alveoli	.080
“ at diastema	.050
“ between last molars	·070
“ “ pterygo-palatine crests	.065
“ of postglenoid process	.095
“ between postglenoid processes	.095
“ basioccipital at front	.073
“ “ “ condyles	.200
“ of space for lymphanic chamber	.034
Length tusk on curve (12.7 inches)	.320
Diameter at middle (antero-posterior)	.050
“ “ base “ “	.063
“ “ middle (transverse)	.030
“ “ crown P. M. 1 transverse	.022
“ “ “ antero-posterior	.024
“ “ M. 1 “ “	.035
“ “ “ transverse	.034
“ “ M. 2 “	.043
“ “ “ antero-posterior	.045
Elevation of shovel above base of apex of nasal	.060

The measurements may require some correction in respect to the supraorbital width, where the cranial walls have suffered from compression. The frontal of one side has been pushed so as to overlap that of the other by about an inch.

The *scapula* is of a sub-triangular form, the front being vertical, the apex directed backwards and an angle upwards. The posterior expansion is considerable, as in the elephants, while the superior angle is acuminate and much produced and massive. The spine is much elevated, bounding a deep supraspinous fossa. It is truncate in front descending to near the border of the glenoid cavity. Its extremity is dilated in alate fashion, equally fore and aft, and not posteriorly only as in the elephants. The glenoid cavity is flattened so as to be longitudinal, and the coracoid is a rudimental tuberosity.

Measurements of Scapula.

	M.
Total length (25.25 inches)	0.640
“ width	.480
Length apex from spine	.140
Elevation of spine proximally	.125
Length of glenoid cavity	.185
Width “ “ “	.110

The interior side of the scapula is strongly convex by the development of two longitudinal ribs, one corresponding to each fossa, but concave in longitudinal section.

The proximal end of the *radius* exhibits two facets oblique to each other, the larger concave and transverse, the other oblique downwards. Transverse width M. 0.130; vertical .070. The extremity of a humerus not found with this individual, to which the radius applies pretty well, has a very oblique trochlear face, and measures seven inches across the condyles. It, however, belongs to a smaller species.

The *femur* is entire. Like that of other species of the group it is much expanded proximally and deep distally, with the shaft contracted and somewhat flattened in the plane of the great trochanter. The latter is in one plane, with its external margin turned a little backwards. The head is part of a globe, and is a little more elevated than the trochanter, and separated from its apex by a shallow concavity. There is no little trochanter. The trochlear face is not elevated nor wide, and with lateral borders subequally developed. The antero-posterior axis of the condyles is somewhat oblique to a line at right angles to the proximal end. On this account the interior condyle is the longer; its articular face is continuous with the trochlear, with a marginal notch; the outer condyle is continuous, with continuous outer margin. Strong ridges revolve from above the condyles to the posterior face of the shaft, the inner near the condyle. The outer runs parallel to the main axis as a low external ala, and backwards three inches above the condyle. The face between them is concave.

Measurements of Femur.

	M.
Total length, (31.75 in.)	0.747
Total proximal width	.255
Diameter of ball	.136
Transverse diameter at middle of shaft	.096
Antero-posterior " " "	.074
" " condyles posteriorly	.150
Transverse " " "	.160
" " " distally	.145

The *pelvis* has a large transverse expansion. The iliac plates are ovoid in outline, with the apex outwards and downwards. The margins are rather thin excepting the internal above the acetabulum. These are massive, and with a longitudinal excavation. They terminate in a deep oblique excavation for the diapophyses of the sacrum. The external margin rises compressed from just above the acetabulum. The latter is large for the size of the ilia, and its margins rise to a slight elevation beneath the exterior margins of the latter. The *incisura acetabuli* is obclavate, and nearly symmetrical. The *os ischium* is compressed and deeper than the pubis. It possesses a tuberosity on the posterior inferior margin. The *obturator foramen* is small and is a vertical oval. The *pubis* is rather slender and short. Its section at base is subtriangular; beyond, it becomes more compressed, and is spirally twisted on itself through part of a circle. Its anterior margin near the symphysis is strongly rugose for the origin of the *pectineus* muscle; the rugosity extends into a band on the outside of its proximal portion.

Measurements of Pelvis.

	M.
Long diamater of ilium	0.605
Transverse do. at acetabulum	.430
Length inferior free margin do.	.250
Long diameter acetabulum	.150
Shorter " "	.130
" " obturator foramen	.070
Width ischium at tuberosity	.140
Length " to "	.110
Diameter pubis at obturator foramen	.062
Expanse of ilia laid on a flat surface and with sacrum in place (4.2 ft.)	1.280

The general character of the pelvis is more like that of the Elephant than that of any Perissodactyle. It agrees with the former and differs from that of the *Rhinocerus* in the shortness of the pedestals of the ilia or rather in the sessile position of the latter on the acetabula; also in the absence of production of the iliac crests in advance of and above the sacrum. It is also elephantine in the shortness of the inferior elements of the pelvis.

Of *vertebræ*, there are preserved a dorsal, two lumbar, and some sacral. The first is very short and transverse. It is so injured that I can only give measurements. The base of the transverse neurapophysis is a flat oval; both capitular articular surfaces are deep. The anterior lumbar is longer, but still short; its articular faces are slightly concave. The neural arch is wide, and supports the diapophysis. The sides of the centrum are concave and pierced by foramina, and there is a strong rugose hypapophysis. The section at the middle is subtriangular. I have three sacral vertebræ which are separated by very distinct sutures. They diminish very rapidly in size, and the centra become flattened transverse. It is doubtful whether there was a fourth vertebra, and the tail must have been short and slender. The articular face of the first is a transverse rather broad ellipse and twice the diameter of the third distally. The diapophysis of the second is much the stoutest. It unites with the subvertical plate-like diapophysis of the first as well as with that of the third. It is concave above, and terminates distally in a massive L-shaped surface of articulation with the ilium. The foramina enclosed by the diapophyses are quite large. The inferior face of the first sacral centrum is slightly concave with a hypapophysial tuberosity in front; it is strongly concave in the second.

Measurements of Vertebræ.

	M.
Antero-posterior diameter of dorsal	0.044
Diameter at bottom neural arch do	.040
Length base of neurapophysis	.041
Diameter centrum lumbar (vertical)	.090
" " " (transverse)	.110
" " " (antero-posterior)	.080
Length three sacral vertebræ	.226
Transverse extent of sacrum (15 in.)	.380
Diameter first vertebra at free end (transverse) (4.6 in.)	.122
" " " " (vertical)	.093
" last " " "	.021
" " " " (transverse)	.065
Total expanse of heads of rib	.106
Diameter capitular face (vertical)	.048
" tubercular "	.030
Width rib just below head	.050

Restoration. We may ascribe to the *Loxolophodon cornutus*, form and proportions of body similar to those of the elephant. The limbs, however, were somewhat shorter, as the femur is stouter for its length than in the *E. indicus*. It was intermediate in this respect between the latter species and the species of *Rhinocerus*. The tail was quite small. The neck was a little longer than in the elephants, but much less than in the rhinoceroses; the occipital crest gave attachments to the *ligamentum muchæ* and muscles of the neck, which must needs have been powerful to support the long muzzle with its osseous prominences, and to handle with effect the terrible laniary tusks. The head must have been supported somewhat obliquely downwards, presenting the horns somewhat forwards as well as upwards. The third or posterior pair of horns towered above the middle ones, extending vertically with a divergence, when the head was at rest. The posterior and middle pair of horns were no doubt covered by integument in some shape, but whether dermal or corneous is uncertain. Their penetrating foramina are smaller than in the *Bovidæ* The cores have somewhat the form of those of the *Antilocapra americana*, whence I suspect that the horns had an inner process, or were palmate as in the prong-horn at present inhabiting the same region. The nasal shovels may have supported a pair of flat divergent dermal horns, but this is uncertain; they are not very rugose.

The elevation of the animal at the rump was about six feet, distributed as follows:

	Inches.
Foot	4.50
Tibia	20.50
Femur	31.75
Pelvis	16.
	72.75

The anterior limb was stouter than the posterior, judging from the proportions in *Eobasileus pressicornis*, and were no doubt more elevated, if of the Proboscidian character. This would give us the hypothetical elevation at the withers:

	Inches.
Leg	61.00
Scapula (actual)	21.00
Neural spines (extremities)	7.00
Or seven feet, five inches	89.00

These measurements are made from the plantar and palmar surfaces, allowance being made for the pads.

The neck, estimating from the dorsal vertebræ and from the cervicals of other species preserved, could not have exceeded one foot in length, and may have been less. This added to the length of the cranium, gives a total of about four feet. The obliquity of the antero-posterior axis of the cervical vertebræ, indicates that the head was posteriorly elevated above the axis of the dorsal vertebræ. Thus it is entirely clear, that the muzzle of this animal could not have reached the ground by several feet, and that, as occurs in the similar cases of the Tapirs and Elephants there was a proboscis to supply that necessity. The indications derived from the bones of the muzzle confirm this conclusion, as has been already pointed out. There could have been no interference from the horns near the ends of the nasal bones, for the bases of these project beyond the origin of a proboscis, and were directed outwards while the latter hung downwards.

This species was probably quite as large as the Indian Elephant, for the individual described is not adult, as indicated by the freedom of the epiphyses of the lumbar vertebræ, and fragments of others in my possession indicate considerably larger size.

Habits. The very weak dentition indicates soft food, no doubt of a vegetable character, of what particular kind it is not easy to divine. The long canines were no doubt for defense chiefly, and may have been useful in pulling and cutting vines and branches of the forest. The horns furnished formidable weapons of defense. That the anterior nasal pair were not used for rooting in the earth is evident from the elevation of the head, which would render this impossible.

This huge animal must have been of defective vision, for the orbits have no distinctive outline, and the eyes were so overhung by the horns and cranial walls as to have been able to see but little upwards. The muzzle and cranial crests have obstructed the view both forwards and backwards, so that this beast probably resembled the *Rhinoceros* in the ease with which it might have been avoided when in pursuit.

Locality. The remains of the *Loxolophodon cornutus* were found by the writer in August, 1872, in a ravine of the bad lands of Wyoming. The greater part of the cranium and the femur were excavated from the base of a cliff of perhaps 250 feet in height, on the side of a ravine elevated about 1000 feet, in the Mammoth Buttes, on South Bitter Creek. As the basin of Bitter Creek is 7,500 feet above the sea, the fossil was taken from an elevation of 8,500 feet. The horizon is the Bridger Group of the Eocene of Hayden.

EOBASILEUS. Cope.

Proceedings of the American Philosophical Society, 1872, p. 485 (Extra copies published by the author, August 20th).

As pointed out above, this genus resembles *Loxolophodon* in the very short cervical vertebræ, but agrees with *Uintatherium* in the rudimental condition of the nasal horn-cores, which are mere tubercles. The posterior or third pair of horn-cores are also very different, and probably stand on the largely developed lateral crests of the superior surface of the cranium, as in *Uintatherium*. They are apparently preserved in *E. furcatum* (which is not the type of the genus), and are compressed from base to summit; in *Loxolophodon* the base is nearly cylindric.

The characters of this genus had not been indicated in any of the descriptions published by palæontologists prior to its establishment as above cited. It is possible that *Tinoceras grandis* of Marsh may be synonymous with one of the species here referred to it, but this point cannot be determined from the descriptions of that author.

The cervical *vertebræ* in *E. pressicornis* are very short. The limbs are much as in *Loxolophodon*, as are the scapula and pelvis. The *symphysis pubis* of *E. pressicornis*, or an ally, is short, and was separated from the ischiadic symphysis, but whether this belongs to the genus is not entirely certain.

The *navicular* bone, of perhaps the same species as the above, displays, as in living proboscidians, four inferior facets, thus proving the existence of five toes to the hind foot. The external facet is deeply concave, and contains a pit. It is oblique, and unites with the superior face by an acute angle. It supported the small inner toe by its metatarsus directly. The other three are more nearly on one plane, and are deeper than wide. The navicular is in form a little less than a quarter of a circle, and the external (anterior) depth is one half its transverse length. Its superior surface is slightly convex.

EOBASILEUS PRESSICORNIS. Cope.

Loxolophodon pressicornis, Cope. Proceed. Amer. Philos. Soc., 1872, p. 580 (published by the author, August 19th). Loc. cit., p. 488 (August 22). *Eobasileus cornutus*, Cope, l. c., p. 485 (Aug. 20th), not *Loxolophodon cornutus*, Cope, l. c., Aug. 19.

Represented by numerous portions of the cranium, with fragments of limbs of one individual; of almost all portions of the skeleton except the cranium, of a second. A humerus with astragalus of a third are of uncertain reference, while a single humerus of another species may belong here. Fragments of several other individuals of appropriate size may pertain to it.

The *cranium* is represented by nasal, maxillary, malar, occipital bones, etc. The first named has a half conic apex, and an oblique compressed tuberosity, which forms the lateral border behind it, and is directed obliquely upwards. The apex of each nasal is vertically compressed acute and is deeply pitted and rugose for muscular or ligamentous attachments. The inferior lateral marginal ridge is contracted, and encloses a concave median space. The tuberosity sinks to the level of the median suture. The posterior part of the nasal rises to the apex of the middle horn-core, forming its inner face. The postero-superior angle of the premaxillary reaches to near the base of the horn, and is not drawn out to a narrow apex as in *L. cornutus*. The horn is compressed antero-posteriorly at the base; at the apex obliquely inwards and forwards. The outer face is concave on the lower half, the inner convex. The posterior face is concave and the anterior convex when viewed from the side.

Measurements of Nasal Bone.

	M.
Width of both at tuberosity	0.124
" " base of distal cone	.060
Depth of suture at front of tuberosity	.030
Length of suture from premaxillary to horn-core	.035
" horn-core (in front) (6 in.)	.150
Diameter (externally)	.080
" of apex	.048

The occipital region is furnished with an enormous transverse crest which extends upwards and backwards. Its margin is gently convex, and its supero-anterior face concave. The posterior is narrowed by the inferior crest-like margins of the temporal fossa which extend from the squamosal part of the zygoma and gradually contract, terminating abruptly in a low knob where it joins the transverse crest. The posterior face between the former is divided into two planes by a low vertical ridge, which terminates some distance below the summit. The transverse crest is continued in a curve forwards on each side as the superior margin of the temporal fossa. The specimen does not indicate whether these supported horns, but they are very stout.

Measurements of Occiput.

	M.
Elevation from *foramen magnum*	0.180
Width between inferior temporal crests	.250
" of condyles with foramen	.180
Elevation above internal sinuses at angles	.180

The mastoid tuberosity is short and stout; the mastoid foramen is large and not piercing a crest. The ex-occipital suture is obliterated. The Λ-shaped crest behind the meatus in *Loxolophodon cornutus* is little marked here. The surface of the bone has various muscular impressions. The basi-occipital exhibits a low median crest dividing lateral concavities;

transverse width at condyles .077 M. The fragments of teeth are too uncharacteristic for specific description. Numerous cranial fragments accompany the above, but have not yet been properly placed.

The *atlas* is broken; its cotyloid cavities are rather shallow, and the diapophyses small. Its antero-posterior diameter below at the middle line is .070; at base of diapophysis .070. The condyles of the *femur* present the characters of the group. There is a deep vertical groove on the inner side just above the condyle. The latter approach each other closely on each side of the intercondylar fossa and are flattened on the superior posterior margins. Width across extremities M. .150.

At a distance of one or two hundred feet from the above specimen I found portions of the skeleton of a smaller animal, probably a different but allied species. It is represented by portions of ribs and limbs, of which the ulna is described under *Uintatherium*. Two or three hundred yards from the typical specimen, I obtained remains of almost all parts of the skeleton of what is probably the present species. The femur is identical in character. The specimen embraces cervical dorsal and lumbar vertebræ, ulna, both femora and tibiæ, astralagus, navicular, etc., and large parts of the scapulæ and pelvis.

The *scapula* in its proximal portions, differs little from that of *Loxolophodon cornutus* besides in inferior size. The coracoid is a compressed tubercle enclosing a groove with the glenoid cavity.

	M.
Diameter glenoid cavity (longitudinal)...............	0.168
" " " (transverse).................	.098

The *os pubis* displays a strong pectineal rugosity commencing near the acetabulum.

	M.
Long Diameter of acetabulum......................	0.143
Length ischio pubic suture..........................	.108
Diameter pubis near acetabulum....................	.052

The *femur* is nearly as long as that of *Loxolophodon cornutus*, but is more slender, and has a relatively smaller head. It is flattened fore and aft, and the great trochanter is much expanded and with a shallow concavity on the posterior face. There is a marked concavity on the posterior face of the shaft above the condyles. There is a rudiment of the little trochanter. The *tibia* is scarcely three-fourths the length of the femur, and has a rather contracted shaft, which is in section rounded triangular, one angle presenting forwards. There is no spine except a rudiment in the swollen upper portion of the anterior ridge. The articular surfaces are together rather narrowly transverse. They are separated by a keel which is undivided posteriorly; anteriorly the contiguous margins of the cotyli separate. The long axis of the inner of these is directed antero-posteriorly outwards in front; of the other similar but much more transverse. It overhangs the shaft outwards and backwards and supports beneath, the subround down-looking fibular articular surface. The distal articular surface is distinguished from allied species by the downward prominence of the malleolar process, the antero-posterior width, and the greater extent of the fibular articular face. The face is slightly concave antero-posteriorly and openly sigmoidal transversely.

Measurements of Leg.

	M.
Length with astragalus in place	1.200
Femur, length	.750
“ diameter ball	.118
“ width at great trochanter	.220
“ “ “ middle shaft	.091
“ depth “ “	.060
Tibia, length	.470
“ width proximal surfaces (transverse)	.147
“ “ “ (antero-posterior)	.070
“ transverse diameter shaft	.061
“ antero-posterior “	.065
“ “ “ distal articulation	.092
“ transverse “ “ “	.121
Fibula, length	.430
“ transverse width at middle	.032
“ width proximal articular face	.042
“ “ malleolar “ “ (transverse)	.052
“ “ “ “ “ (longitudinal)	.044

A section of the fibula, near the proximal end, is sub-triangular; a short distance below, sub-circular; on the distal two-thirds it is flat, with the thinner edge convex inwards.

The *astragalus* is a flat bone, with its entire superior face occupied by the tibial articular surface. This is as broad as long, and very little convex. It is broader in front than behind; the outer margin is concave, the inner slightly convex. The posterior margin projects most on the outer side, and it is divided by a pit-like cavity, which sends a groove to the inner margin. The outer malleolar surface is an antero-posterior oval; the inner, a concavity, beyond which the inferior portion of the bone projects. The inferior face is divided by a prominent transverse angle, between sub-anterior and sub-posterior faces. The latter receives the calcaneum on two oval surfaces, which are joined behind by a narrow strip. The navicular face is sub-rhomboid, the cuboid one-third as large, and triangular, with a round base outwards. The margin of the former scarcely projects beyond the superior face.

Measurements of Astragalus.

	M.
Total width	0.128
“ length	.107
Width tibial face in front	.090

	M.
Length tibial face externally	.088
“ internal malleolar face	.045
“ outer calcaneal do. antero-posteriorly	.050
Length navicular facet	.095
Width do. (antero-posterior)	.060
Length cuboid facet	.065
Width do. (antero-posterior)	.035

A *navicular* belonging to the individual mentioned first has been already described.

Measurements of Navicular.

	M.
Depth in front	.048
Width (transverse)	.097
“ of external facet	.035
“ “ second	.026
“ “ third	.047
“ “ internal	.023

A distal end of a humerus was found with two astragali about a hundred yards from the last individual. The articular face is very oblique to the transverse axis, but is about equally developed on opposite sides of the shaft. The condyles are unequal, have parallel axes, and are separated by but a shallow concavity. The fossæ of opposite sides are not very large nor deep.

Measurements of Humerus.

	M.
Transverse diameter distally	.175
Do. of inner condyle	.104
“ outer “	.125
Transverse diameter olecranon	.110

The portion of *ulna* just measured belongs to the individual of which so many fragments were found, or No. 2.

The dorsal *vertebræ* of the same are somewhat distorted by pressure; I will therefore describe a cervical of natural form. The centrum is very short, and the articular face is a wide, transverse oval. Both are slightly concave, and the axis being slightly oblique, the anterior is the more elevated. The surface of the latter is quite rugose, except on the margins. The cervical canal is wide, and the neur- and parapophyses narrow. Inferior surface regularly convex.

Measurements of Cervical Vertebra.

	M.
Length centrum	.044
“ basis neurapophysis	.040
“ anterior articular face	.102
Depth “ “	.086
Width neural canal at base	.060

Restoration. The elevation of this animal was not much less than that of the *Loxolophodon cornutus*, but the proportions were more slender. As in all the species of *Uintatherium* in which the horns are known, these appendages stood in front of the orbits, and nearer the nareal opening than in the type of the former genus. The muzzle, too, is materially shorter and more contracted, and the true apex of the muzzle was not overhung by the great cornices seen in *Loxolophodon*. The horn-sheaths were probably simple, while in *L. cornutus* they were probably palmate. The occipital and parietal crests are much more extended in this species than in the *L. cornutus*, so that in life the snout and muzzle had not such a preponderance of proportion as in that species. All the species of this genus were rather more rhinocerotic in the proportions of the head, although the horns and tusks produced a very different physiognomy. The extremities of the nasal bones, though not excavated as in that species, are strongly pitted and exostosed, and this taken in connection with the elevation of the head renders it probable that this species also possessed a proboscis.

History. This species was originally described by the writer in a short paper, which was published and distributed August 19th, 1872, under the generic name *Loxolophodon*. I shortly afterwards referred it to the new genus *Eobasileus*, under the name *cornutus*, under the impression that it was the same as the *Loxolophodon cornutus;* but finding this was not the case, I again used the specific name here adopted. More than a month later Prof. Marsh (September 21st) described a species under the name of *Tinoceras grandis*, which agrees with this one so far as relates to the length of horn-cores, but that it is the same species cannot now be positively asserted. I originally (August 20th, 1872) alluded to the horn-cores as situated on the frontal bones; Marsh has since asserted them to be composed of the maxillaries. I have discovered on the first opportunity of making a detailed examination, that the inner face is composed of the posterior part of the nasal bones, and the exterior of the maxillaries.

EOBASILEUS FURCATUS. Cope.

Loxolophodon bifurcatus, Cope, in extra copies on Proboscidians of the Eocene of Wyoming, mailed by the author, August 19th 1872.* *Loxolophodon furcatus* in the same, Proceedings American Philosophical Society, 1872, p. 580, September 20th. L. c. 488, August 22d.

This species was originally described from a large horn-core whose extremital part resembles strongly the nasal shovel of *Eobasileus cornutus*, on which account I referred it to that position on the skull. Marsh has described somewhat similar horn-cores from the lateral crests of the skull behind in *U. mirabile*, whence it may be that my specimen is referable to that position, although it differs much from those of that species.

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* See Proceedings American Philosophical Society, 1872, p. 515, where this name is recorded.

The basis is very narrow and lenticular; a short distance above it the outer side is convex. The anterior and posterior extensions of the base differ; the one is thinner, the other more massive and with a shallow groove above its commencement. The latter may be posterior. If so, the compressed apex of the horn-core sends down a rib outwardly to the anteriorly and one inwardly, which disappears on the convex base. The general form is spatulate with the apex expanded obliquely across the lateral crest, and regularly rounded in superior outline. Its anterior face is flat, the posterior convex; its surface is grooved by very small blood vessels.

As compared with the posterior horn-core of *Loxolophodon cornutus*, there is every difference. That is continuous with one margin of the crest; this, erect above it; that has a round base, this a lenticular one. It is more like that of *U. mirabile*, which I only know from Marsh's figure, but abundantly distinct. It is much more elongate, especially above the posterior? part of the crest, and is flattened, and without the triangular section of that species.

Measurements of Horn-core.

	M.
The total length above crest (5.5 inches)..............	0.135
" " " " base (7¼ inches)..............	.180
Width across apex (in front).........................	.095
Thickness across apex (in front).....................	.028
" at base...................................	.040

It is not certain that this horn may not belong to the *E. pressicornis*, if it be a posterior core, of which, however, I am not yet entirely sure. In that case the name *furcatus*, under which it was first described, becomes a synonym of *E. pressicornis*.

UINTATHERIUM. Leidy.

Proceedings Academy Natural Sciences, Philadelphia, 1872, page 169 (published early in August). *Dinoceras*, Marsh, Amer. Journ. Sci. Arts, 1872. October, 1872 (published September 27).

This genus resembles the last in its general proportions, but differs in its more elongate cervical vertebræ. The centra of these are flat at both extremities, but have not such a marked elephantine abbreviation as seen in the two genera above described. This enabled the head to approach the ground more nearly, and as the limbs were shorter in some of the species, they no doubt modified the length of the proboscis, if present.

Several names have been applied to this genus. Professor Leidy's name here employed, bears date early in August, but of the precise day I am not informed. Professor Marsh, in the Am. Jour. Sci. and Arts, 1872 (Sept. 21st), applied the name *Tinoceras* to a species (*T. grandis*) perhaps of this genus, and gave a description in which some of the generic characters may have been mentioned. He had previously applied it without description to the *Uintatherium anceps*, Aug. 24th (and 19th*, in an erratum, where *Mastodon anceps* is altered into *Tinoceras anceps*). As no characters whatever were assigned to it on either of these occasions, it had no value in zoölogical nomenclature, and must bear date September 21st. Under date of September 27th, Prof. Marsh proposed the name *Dinoceras* (American Journal Science Arts, 1872) for the *U. mirabile*, but did not give his reasons for separating it from his former genus (the names of the two bear an objectionable resemblance), or those published by Dr. Leidy, or myself. Until such reasons be adduced, I retain it also in *Uintatherium*, as is done by Dr. Leidy.

I am acquainted, by autopsy, with two species of this genus. None of them are so large as the *Eobasileus pressicornis; U. robustum*, Leidy, is smaller, and the *U. lacustre*, Marsh, smaller still. *U. mirabile* (*Dinoceras*, Marsh) is about the size of the *U. robustum*, and nearly allied to it; but it may be distinct, as it has a larger mastoid process. *Tinoceras grandis*, Marsh, agrees in measurements with the *E. pressicornis*, and is perhaps that species or the *E. furcatus*. The *Tinoceras anceps*, Marsh, has been so imperfectly characterized as to be practically unknown. It is one of the smaller species, and is most likely to be identical with the *U. robustum*, whose name it antedates. Until these points be cleared up, I retain three species, as follows: *Uintatherium robustum*, Leidy; *U. mirabile*, Marsh; *U. lacustre*, Marsh. For convenience I compare these species with those of *Eobasileus*.

The naso-maxillary horn-cores have been seen in *E. pressicornis* and *U. mirabile*, and the nasal tubercles in the same. The posterior horn-cores are known in the *U. mirabile*. The posterior and lateral crests of the cranium inclose a basin-shaped concavity above in all these species; it has been observed in all but *E. furcatus*. The dentition is similar to that in *Loxolophodon*, *i.e.*, I. 0; C. 1; P. M. 4; M. 2. The first premolar in *U. lacustre* has an internal cone and outer concave crest. The worn surfaces of the other teeth in that species, *U. robustum* and *U. mirabile*, are narrow ovate, with a deep exterior emargination. The true molars support two crests, which converge inwards and unite with a small tubercle behind the apex in *U. lacustre* and *U. robustum*. The tusk is long, compressed and double-edged, as in *Loxolophodon*. The last inferior molar in *U. robustum* possesses three transverse crests, the posterior two parallel, and obliquely directed inwards towards the axis of the anterior, which is the highest.

In a specimen of one of the smaller species, the *ulna* widens considerably distally, being nearly as wide as the olecranon. The latter is large, flattened and subtransverse, and presents a sharp ridge internally. On the inner side of the distal part of the articular face for the humerus is a tubercle, from which a short, wide groove runs out on the inner face of the bone, the head of the radius is a little exterior to the middle line, and the shaft crosses the ulna in an open, shallow groove to the inner side.

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* These papers were not received by me till early in December, 1872.

The *cuboid* is flat, and displays two proximal and two distal articular facets in *U. furcatum*. The astragalus of the same species is subbifurcate posteriorly, and has internally an extensive, oblique malleolar fossa. The *calcaneum* is short and massive, with two superior and one small anterior articular facet.

The species may be thus distinguished :

1. Large species (occipital condyles extending over about M. 0.170.)
Naso-maxillary horns long ; tibia with wide articular faces.. *E. pressicornis.*
Horn-cores flat, elevated.............................. *E. furcatus.*
2. Species of intermediate size.
A prominent mastoid process, molars smaller.......... *U. robustum.*
Mastoid process not prominent; maxillary horn-cores low, triangular; posterior horn-cores short, triangular in section *U. mirabile.*
3. Smallest species (occipital condyles extending over about M. 0 .95.)
Molar teeth larger, the last with a posterior expansion.. *U. lacustre.*

Previous to describing the species I notice a part of the skeleton of a large mammal, second only in bulk to *Loxolophodon* and *Eobasileus* above described.

These, which were not found in association with a cranium, consist of several vertebræ, some carpal bones, the entire hind limb of the left side except the toes and the cuneiform and navicular bones.

The odontoid process is very stout, with a descending trihedral apex. Length M. .078, diameter at base, .048. A dorsal vertebra with a single (anterior) capitular articular face, is quite concave in front.

	M.
Diameter antero-posteriorly..........................	.057
" vertically..................................	.094

A cervical vertebra has the proportions of the dorsal as to its centrum, thus differing materially from species previously described. The articular surfaces are slightly concave.

	M.
Length (antero-posteriorly)..........................	0.065
Diameter vertical....................................	.087
" transverse................................	.100

The *femur* resembles that of the other species already described, but is remarkable for the relatively small size of the head. While the lengths of the bone are not very different, and the expanse of the great trochanter about the same, the head of *L. cornutus* is large, the present one is very much smaller, and that of *E. pressicornis* intermediate. There is a rudimental third trochanter, and the condyles are as large as, and similar to those of, *E. pressicornis*. The external marginal condylar ridge is quite short. The shaft is broken and some small pieces lost ; it is now 26 inches long, but was no doubt longer when complete.

Measurements of Femur.

	M.
Expanse of great trochanter	0.230
Diameter of head	.109
" " shaft at middle	.093
" above condyles	.152
" at extremity of condyles	.139
" (vertical) of inner condyle	.125

The *tibia* is perfectly preserved. It is short and stout and with massive extremities. The outer basal part of the spine remains and is prominent. The cotyli are not oblique; the inner is subround, the outer transverse, widening outwardly; their long axes are at right angles to each other. The crest is a low ridge of contact of the cotyli. The superior fibular face is a transverse oval; the inferior much smaller than in *E. pressicornis.* The shaft is contracted, and flattened behind and on the inner side. The distal extremity is transverse, less truncated for the fibula than in *E. pressicornis,* less convex behind, and with a less prominent external malleolus. The point dividing the astragalus behind is more prominent.

Measurements of Tibia.

	M.
Total length	0.398
Diameter head longitudinal	.080
" " transverse	.138
" shaft transverse	.063
" " antero-posterior	.060
" distal articulation "	.077
" " " transverse	.113
" " extremity, fore and aft	.093
" " " transverse	.125

These measurements show that this bone is considerably shorter than in *E. pressicornis,* though of equal distal diameters. In both species the measurements considerably exceed those given by Marsh for his *Titanotherium* (?) *anceps.* The form of the articular extremities differs from both in being more narrowed and transverse.

The *fibula* is larger proximally and smaller distally than in *E. pressicornis.* Diameter proximal articular face .039; of the distal .045.

The *astragalus* is similar in size and form to that of *E. pressicornis,* but differs in two points. The posterior margin is deeply incised for the ligamentous insertion, and the outer lobe is clearly cut to this fossa, on the inner side. There is a pit for a ligament on the convexity of the inner part of the middle of the tibial articular face. A third difference is seen on the inferior face. The inner calcaneal facet is longer and narrower, and is margined on the inner side by a large fossa parallel to its axis, which is wanting in the other species. The *calcaneum* is short and wide;

its only anterior articulation is with the cuboid and is small. The heel is deeper than long and is obliquely truncate downwards and inwards.

Measurements of Calcaneum.

	M.
Length	0.105
Width	.092
Depth in front	.056
Length heel	.047
Depth "	.055
Length cuboid facet	.038

The *cuboid* is a flat sub-triangular bone with two unequal articular faces below.

	M.
Length	.064
Width	.076
Depth	.031
Length cuneiform (antero-posterior)	.040
Depth "	.017

A *humerus* of a third specimen may or may not belong to this species. It was found in another locality. Its condyles are much less oblique than in that one described under *E. pressicornis*. It belonged to a larger animal, see

Measurements of Humerus.

	M.
Transverse diameter distally (7.75 in.)	.195
" " inner condyle	.125

The olecranar fossa is shallower.

Remarks.—The remains were discovered by the writer in the Bridger Bad Lands on South Fork of Bitter Creek, Wyoming.

UINTATHERIUM ROBUSTUM. Leidy.

Proceedings Academy Natural Sciences, Philadelphia, 1872, p. 169, August. *Uintamastix atrox*, Leidy, l. c. (? ?) *Titanotherium anceps*, Marsh, American Journ. Sci. Arts, 1871, p. 35.

I have been able to examine, through the kindness of Prof. Leidy, the type of his description, and find it to belong to a smaller species than any of those above described. The lateral parietal and supra-occipital crests are well developed, and the latter extends obliquely backwards. Several peculiarities are to be observed in the dentition. Thus there is great inequality in the height of the transverse crests of the posterior upper molar, the anterior, or the arched one, rising to a high cusp at its outer extremity. A small tubercle exists on the side of the inner angle of the grinding surface in the penultimate molar. The same angle is much elevated in an anterior molar. The canine is wider distally than in *L.*

cornutus, and less recurved. The mastoid process is quite prominent. The humerus has a prominent internal condyloid ridge and tuberosity, and the condyles are not very oblique. The inner posterior lobe of the tibial face of the astragalus is quite well defined; there is no median ligamentous pit on the trochlear face.

Measurements (from Leidy).

	Inches.
Depth lower jaw at last molar	3.25
Length humerus about	21.
Diameter at condyles	7.50

Found by Dr. J. V. Carter and Dr. Leidy near Fort Bridger, Wyoming.

Dr. Leidy has suggested that this species and the *Dinoceras mirabilis* of Marsh are identical.

UINTATHERIUM MIRABILE. Marsh.

Dinoceras mirabilis, Marsh, Amer. Journ. Sci. Arts, 1872, October (published Sept. 27). Loc. cit. Jan. 28th, 1873.

The cranium of this species has been very partially described as above cited, but from figures in the last named paper, largely supply the deficiency. From this it is evident that it differs from *Loxolophodon cornutus* in the generic characters already mentioned, and, further, in the anterior position of the naso-maxillary horns, the perforation of the lachrymal, the anterior development of the malar, the oblique occiput, &c. It differs from the *E. pressicornis*, besides the inferior size, in the shorter nasal bones and greater posterior approach of the pre-maxillary bones to the base of the horns; in the much shorter horns and greatly smaller part taken in their composition by the nasals.

These differences account for the great number of errors committed by Prof. Marsh in his allusions to other species, especially *Loxolophodon cornutus* described by me (see his second article above quoted).

Measurements (from Marsh).

	M.
Length of cranium (28.5 inches)	.722
Width over orbits	.203
" between summits naso-maxillary cores	.169
" " " nasal "	.038
Height naso-maxillary cores (3 inches)	.075
Length canine (9.25 inches) below jaw	.232
Diameter fore and aft at base	.064
" transverse " "	.025
Length of molar series	.150
Last superior do	.036

UINTATHERIUM LACUSTRE. Marsh.

Dinoceras lacustris, Marsh, l. c. October, 1872. (Published September 27th, 1872.)

I have several of the teeth and the occipital, parietal and other portions of the cranium of this species. It is distinguished from its congeners, apart from its smaller size, by the large size of teeth. These are nearly as large as those of *Loxolophodon cornutus*, and considerably larger than those of *U. robustum* and *U. mirabile*. The occipital condyles are not larger than those of the Elk, Cervus canadensis. The mastoid protuberance is prominent, and the post-glenoid process more produced downwards and with less fore and aft diameter than in the other three species. The inferior temporal ridge is strongly marked, and the posterior condyloid foramen is large.

The posterior molar has a wide floor extending from the posterior or straight transverse crest to the cingulum. This crest is low and has a low tubercle near its apex behind. The other molars have strong fore and aft cingula but none at ends. The worn surfaces are first V-shaped, later arrow-shaped. The first premolar has curved outer crest and inner conic tubercle.

Measurements.

	M.
Diameter of occipital foramen and condyles..........	.092
From exterior end condyle to mastoid................	.058
" " " " to post-glenoid process....	.080
Transverse diameter last upper molar................	.045
" " third premolar..................	.029
Length molar series................................	.163

Found by the writer in the Bridger formation of South Bitter Creek; Wyoming.

MEGACERATOPS. Leidy.

Proceedings Academy Natural Sciences, 1870, p. 1. Hayden's Geological Survey, Wyoming, 1872, 352 ("*Megacerops*").

This genus is only known from the extremity of the nasal bones bearing the horn-cores. The latter are intermediate in position to the nasal and naso-maxillary horns of *Eobasileus, etc.*, and may represent the median pair, in which case, the diagnosis of the genus should be, nasal horn-cores wanting.

The genus was originally regarded by Dr. Leidy as allied to *Sivatherium* and therefore Ruminant; he also supposed that it possessed a proboscis "as in the tapir." The latter proposition has much in its favor, especially as the affinities of the genus are evidently with the *Proboscidia*.

MEGACERATOPS COLORADOENSIS. Leidy.

Megacerops Coloradoensis. Leidy, l. c.

The part of this species preserved, indicates an animal of the size of the largest *Uintatheria*. The nasal bones are coössified, and the horn-cores are sub-cylindric, obtuse and about two inches in length. They are situated above a point a little behind the anterior nares.

PANTODONTA.

As already pointed out, the structure of the limbs and feet in this suborder is as in the order generally, and the scapula has the same form in general. There is also a resemblance in the form of the symphysis mandibuli, which though furnished with teeth, forms a long solid spout comparable to that of the Elephant. The astragalus has a very peculiar form, being even more exceptional than in *Uintatherium*. The superior articular surface is flat or concave in the middle. It is turned inwards in front of the articular face for the inner malleolus, terminating in a long point. The cuboid articular face is quite small and sublateral. The fibular facet is extensive, and the internal lateral well marked.

On the other hand the coracoid process is produced into a curved hook, and is thus more largely developed than in other Proboscidians or Perissodactyles. The neck is longer than in the other Proboscidians, and the parietal bones appear to be narrowed by the approximation of the temporal fossa, as in the *Rhinocerus*. Almost nothing however is known of the structure of the skull.

The genera are two, as follows:

Penultimate molar unlike the last, with external crescent and embracing ledge.. *Bathmodon*.

Three molars alike, with two transverse crests not meeting within.. *Metalophodon*.

BATHMODON. Cope.

Proceedings American Philosophical Society, 1872, p. 417.

This genus was originally chiefly distinguished by the dentition; at present many other important peculiarities are added. First, as regards the molar teeth; the two transverse crests I find to be separated (not united) at their inner extremities, by a narrow fissure. The anterior is much the longer, and is curved; its anterior wall slopes steeply down to the narrow cingulum. The posterior is short, and straight, and bears a crest. The numbers are I. 3; C. 1; P. M. 4; M. ? 3.

The entire mandible presents the following dentition; I. 3; C. 1. P. M. 4; M. 3. The incisors radiate round the narrow extremity of the trough-like symphysis, and have transversely expanded crowns. The canine is inclined forwards and forms part of the same series. Its crown is triangular in section, the outer face convex. In the males it was enormously enlarged as indicated by a symphysis in my possession. The anterior premolar approached the canine. The former teeth have an external chevron directed inwards, whose extero-superior surface of enamel is acute cordate. Beside this is a little longitudinal ridge, which represents another chevron of the true molars. On the first of the latter, both chevrons are developed, the posterior the least, both with their anterior ridge boundaries lowered; they sink entirely on the last two molars, which become thus two crested as in those of some Tapiroids and the premolars of *Dinotherium*.

The sternal segments are cylindric; in one the articulations for the hæmpophyses project laterally, giving the piece a T-shaped form. The atlas has a flat diaparapophysis, presenting its edges fore and aft; the arterial canal traverses it obliquely. The coracoid is double, having a tuberosity on the edge of the glenoid cavity, and a prominent hook just outside of it. The lumbar vertebræ are quite short. The cuneiform bone is narrow pyriform, with two triangular facets on one side, the smaller being sublateral; and one twisted over the other. The ungueal phalanges are very short, somewhat flattened and with the terminal portion transverse and rugose as in some toes of *Palæotherium*.

In the remains pertaining to this genus obtained by Dr. Hayden, there are numerous individuals of apparently three species. Two of these are larger and one smaller, the latter in part indicated by an individual without epiphyses on the lumbar vertebræ. It presents marked difference in the form of the astragalus atlas, scapula, etc.

a Larger species.

Astragalus everted in front; nearly as wide as long;
lower premolars narrower, more elevated and rugose... *B. radians.*
Lower premolar broad, lower, and smooth.......... *B. semicinctus.*
aa Smaller species.
Astragalus much wider than long, decurved in front.. *B. latipes.*

BATHMODON RADIANS. Cope.

Proceedings American Philosophical Society, 1872 (February 16), p. 418. Hayden's Geological Survey of Montana, 1871, 350.

In addition to the characters already assigned to this species as above cited, I add the following:

The apex of the *scapula* is a massive flattened acumination with truncate extremity. The spine is elevated and truncate next the glenoid cavity, which is a wide oval, much produced at the coracoid margin. The transverse process of the *atlas* is rounded distally and is about as long as wide; the surface for the axis is directed obliquely inwards. The *fibula* has the inner sharp edge prolonged to the proximal end; the form of the latter is much as in *Eobasileus*. The *astragalus* is slightly concave in both directions on the trochlear face, most so antero-posteriorly. The anterior outline of the same is strongly and obliquely convex, and the surface is produced sideways into a latero-anterior apex. The inner malleolar border is thus very concave; the outer is gently convex with a long fibular facet. The posterior margin concave, the inner tuberosity prominent. The *navicular* facet is as broad as long, and nearly sessile, being probably separated by a groove from the tibial. The cuboid facet is subround, small and sublateral. The calcaneal situated diagonally opposite each other. The antero-internal is twice as large as the other, is transverse and truncate internally by a facet near the apex, at right angles. The other calcaneal facet is subround.

Measurements.

	M.
Length ramus mandibuli to anterior margin of coronoid process	0.310
Length premolars and molars	.218
“ last molar crown	.040
Width “ “ “	.030
“ “ premolar crown	.018
Length last premolar	.025
Width symphysis at canines	.045
Diameter canines ♂	.028
“ “ ♀	.023
Length exposed portion incisor 2	.026
Width crown “ “	.0245
Length diapophysis atlas	.047
Width “ “	.056
“ facet for axis	.053
“ glenoid cavity scapula (straight)	.086
Length coracoid from inner basis	.045
“ proximal articulation fibula	.027
“ distal “ “	.042
Diameter shaft “	.022
Total length astragalus (fore and aft)	.072
“ width “	.065
Length navicular facet	.045
Width “ “	.034
“ cuboid “	.025
Length “ “	.023
“ anterior calcaneal do	.040
Width “ “	.024
Length posterior “	.021
“ fibular (axial)	.043

The teeth are slightly rugose, and the inferior canines show a tendency to imitate the form of the incisors in a slight basal angular expansion of the crown. This forms an approximation to the tapirs. The middle pair of incisors is directed outwards, is the smallest, and like all the others has the roots much exposed.

This species was originally described from teeth of the upper jaw. I have since obtained the entire mandible (except the angles) taken out at the same place and near the same time. The size, color, etc., would indicate that they belong to the same individual. Accompanying the first specimens were many bones of individuals of different sizes, which I learn from the finder were all taken from within a short distance of each other. Many of them belong to the same species, as the jaws and teeth, and I have described as such those that relate properly to them as to size, mineral appearance, etc.

The smaller specimens belong also to several individuals, and possibly to more than one species. I describe them together, but regard the astragalus as the primarily distinctive bone.

BATHMODON SEMICINCTUS. Cope.

Proceedings American Philosophical Society, 1872, p. 420. *Loxolophodon semicinctus*, Cope, l. c.

The tooth on which this species was based shows a near relation to the corresponding one of *B. radians*.

BATHMODON LATIPES. Cope. Species nova.

Established on atlas axis, dorsal and lumbar vertebræ, scapula, humerus, phalange, femur, astragali, etc., of a specimen found with the *B. radians*.

The transverse process of the atlas is stouter and less flattened at the base than in *B. radians*. The axis is but little oblique and has a low obtuse hypapophysis below. Its form is much as in the larger species, being rather elongate, but shorter than in *Rhinocerus* and other Perissodactyles. The dorsals and lumbars are short and plane ; the former are obtusely, the latter acutely keeled below. The head of the femur has no ligamentous fossa. The astragalus is considerably broader than long, the apex turned outwards in front of the inner malleolus, being especially produced. The tibial face is concave transversely, and convex anteroposteriorly at the front, plane behind. There is a posterior submarginal foramen, which is not bridged over in one specimen, producing a deep notch. The navicular facet has considerable transverse extent, and the anterior side of the bone is more transverse than in *B. radians*. The calcaneal facets are diagonally opposite to each other ; the outer is subround, the inner anterior narrow and transverse. It differs in the two specimens, the perforating foramen not being bridged over in the one (the type) with the similar posterior interruption described above. This may be due to fracture. The only ungual phalange has the articular face not quite sessile on the transverse rugose free extremity.

Measurements.

	M.
Diameter diapophysis atlas (fore and aft)	0.036
" axial facet of "	.034
" centrum axis (transverse)	.080
" " " (vertical)	.037
Length " " to odontoid	.057

Width neural canal do		.030
Diameter of centrum of dorsal	fore and aft	.040
	vertical (total)	.043
	transverse	.059
" neural arch of same	vertical	.018
	transverse	.032
" centrum of lumbar	antero-posterior	·041
	vertical (total)	.050
	transverse	.063
" head of femur		.060
Length astragalus fore and aft		.050
Width "		.065
Length navicular facet		.049
Width " "		.020
" cuboid "		.018
Length " "		.016
Width (fore and aft) anterior calcaneal		.018
Length posterior calcaneal facet		.022
" fibular (axial)		.041
" terminal phalange		.012
Width do proximally		.015
" distally		.030
Diameter glenoid cavity scapula	vertical	.051
	transverse nr	.080

From the beds of the Green River epoch near Evanston, Utah (now Wyoming).

METALOPHODON. Cope.

Proceedings American Philosophical Society, 1872, p. 542. (Published September 20th.)

In distinguishing this genus from *Bathmodon*, I stated that the differences were in the dentition so far as known; *i. e.* that the crests of the true molars are not united internally and that the premolars are two—not three—crested. I would now add to the characters, that there are three molars on each side, with transverse crests, which do not unite at the apex, except in the case of the anterior, when they are slightly connected. In *Bathmodon* there is but one such tooth, the posterior. The inner or third crest of the posterior premolar of that genus is only a cingulum, and is not probably a generic character.

METALOPHODON ARMATUS. Cope. Loc. cit.

This species is represented by the greater part of the dental series of both jaws, which I took from a decayed cranium myself, and can thus be assured of their mutual relations. One of the true molars at least, belonged to the milk series, as indicated by the unworn crowns of the successional teeth accompanying. Some of the premolars are but little worn. Referring to my original essay for the general description, I append exact

Measurements of the Teeth.

	M.
Total length of a superior incisor	.057
Length crown (inner face) superior incisor	.015
Width " (oblique) " "	.020
" " " inferior "	.023
Length " (inner face) " "	.018
Width canine .030 from tip	.020
" posterior molar	.039
Length " "	.028
Elevation posterior crest do.	.016
Width anterior true molar	.035
" premolar	.028
Length "	.0215
" " (first)	.016
Width " "	.008
Length " (inferior)	.024
Width " "	.020
" penultimate lower molar	.023
Length " " "	.037

It is not certain that the last named species of *Bathmodon* does not belong to this genus. All three are distinct from the *M. armatus*, the latter though young, being considerably larger than *Bathmodon latipes*.

APPENDIX.

The materials on which the preceding determinations are based, were obtained by the Geological Surveys conducted during 1871-2, by Prof. F. V. Hayden, U. S. Geologist.

The papers descriptive of fossils from the Wyoming basin published by the writer during the year 1872, were issued at the following dates:

On *Bathmodon*, an extinct genus of Ungulates, February 16th.

On a new genus of *Pleurodira* from the Eocene of Wyoming, July 11th.

On the Tertiary coals and fossils of Osino, Nevada, July 29th.

Descriptions of some new *Vertebrata* from the Bridger Group of the Eocene, July 29th.

Second account of new *Vertebrata* from the Bridger Eocene, August 3d.

Third account of new *Vertebrata* from the Eocene of Wyoming Territory, August 7th.

On the existence of *Dinosauria* in the Transition beds of Wyoming, near August 12th.

Notice of *Proboscidians* from the Eocene of Southern Wyoming, August 19th.

Notices of new *Vertebrata* from the upper waters of Bitter Creek, Wyoming Territory, August 20th.

Second notice of extinct *Vertebrates* from Bitter Creek, Wyoming, August 22d.

On the Dentition of *Metalophodon*, September 20th.

On a new Vertebrate genus from the northern part of the Tertiary Basin of Green River, October 12th.

Descriptions of new Extinct Reptiles from the Upper Green River Eocene Basin, Wyoming, October 12th.

The above essays were distributed widely at the above dates, excepting that on *Metalophodon*.

In an article on *Uintatherium mirabile*, Prof. O. C. Marsh criticizes the statements made in some of the above essays, denying their accuracy. In reply to such of them as are not frivolous, I would say that I make no corrections of them at present (except one, which I made prior to the appearance of his remarks), but show that his statements were based on species different from those described by me. These he has either not seen or not studied.

In applying the law of priority in nomenclature, I have endeavored to practice the rules adopted by the majority of students, and which I believe to be founded in justice. They are as follows:

(1.) Priority reposes on date of publication not on reading of memoirs.

Note. What is necessary to determine the time at which a discovery of scientific truth is made, is the earliest reliable evidence of such discovery. As verbal and written assertion cannot be preserved inviolate, printing is necessary to secure the record from change. The earliest evidence of such printing is that offered by printers, who issue the work, and any person who receives it from them. It is then published. Ordinary books bear such date of publication, whether distributed, sold, or standing on the author's shelves.

(2.) In order that a specific name be adopted it must be associated with a description of the object to which it refers.

Note. The necessity of this rule is self evident, since the only value of scientific literature is to convey definite information, which a name does not. Moreover the worst description will generally embrace at least one peculiarity of a species, which will serve to fix the name, but a label, or the specimen itself, may readily be lost or transposed in a museum. Further, in writing descriptions it is necessary to introduce as many points as possible, not only to distinguish the species from those already known, but from those which may in future be discovered; for it is with these that difficulties chiefly arise.

(3.) In order that a generic name be adopted, it also must be accompanied by a description.

Note. Since naturalists differ to some extent as to what they term a genus, some may be disposed to doubt the expediency of this rule, but its importance to science appears to me greater than in the case of species. In the first place, scientific literature being designed for the communication of exact knowledge, it is essential that its words should represent ideas. The genus is as definite a mental conception as a species, to the *scientific* thinker, and in proposing a name, should also express what it represents in his mind. Without such expression it is safe to suppose that no such idea exists; and if so, the name should be regarded as a cipher in the literature of science.

That certainty as to the limits and hence definition of a genus is not at once attainable, is no objection to the above rule. By study of known forms definite knowledge of generic characters may be attained by proper analysis. But whether correct or not, a generic description expresses something definite, and gives the name a currency which should remain as a record of honest work.

The evils which come from the opposite course are numerous. They are: 1st. Names without description are unintelligible, and communicate nothing. 2d. They serve to conceal the ignorance or incompetency of their authors. 3d. If allowed, they open the door to the introduction of names on geographical and stratigraphical grounds; a slovenly pratice, indulged in by a few palæontologists, and properly denounced by Falconer, as assuming at the outset what it is the design of the science to prove. The same practice attempted in zoölogy has been utterly condemned, as for example in the case of the System Reptilium, published in 1843. Here pages of generic names may be found, with type species indicated, which have no authority whatever. 4th. The practice lays the science open to the inroads of charlatans and scientific pirates, who seek to impose a nomenclature without the labor of discovering a system or describing its objects. 5th. As the genus is a more important conception in palæontological science than the species, it is more important that what its name represents should be clearly understood, otherwise generalizations become impossible or incomprehensible.

(4.) When a supposed genus is found to consist of several, and the author has stated what he regards as the type of the former, that species must retain the original name. Where the type of the original genus is unknown, the original name must attach to that genus which remains, after subtraction of the others found to be embraced in the original assemblage.

Note. This rule is adopted as doing less violence to long accepted views and practice in nomenclature than any other. While recognizing the work of the original author, it also preserves record of the labor of those who have determined the true divisions with more exactitude.

EXPLANATION OF PLATES.

Pl. 1. *Loxolophodon cornutus*, Cope, profile less than one-sixth natural size.

Pl. 2. The same from the front.

Pl. 3. Superior view of the same.

Pl. 4. Inferior view.

ON THE ARRANGEMENT OF THE FAMILIES OF COLEOPTERA.

By G. R. Crotch, M. A.

(*Read before the American Philosophical Society, February* 7, 1873.)

Since the publications of Dr. Leconte and C. G. Thomson, the classification of the order Coleoptera has been placed on quite a new footing, and though the old divisions are in great part retained, yet they are defined by entirely fresh characters and are purged of various heterogeneous elements that had been added to them. Thomson has, indeed, developed a singular classification, differing very widely from any in use, hence I have only been able to avail myself of the details; and certainly no other author has shown such minuteness of observation, though unfortunately he has confined himself entirely to the Swedish fauna. It is, however, to Dr. Leconte that we owe the most brilliant and fundamental generalization, namely, his isolation of the *Rhynchophora* by the structure of the prosternum; the remaining groups can then be worked out with comparative ease, though the three divisions into which they naturally fall do not admit of being sharply and definitely characterized. Hence I propose to divide the Coleoptera, as follows:

A. Anterior coxal cavities closed by the junction of the epimera, elytral epipleuræ obsolete, head more or less rostral, tarsi 5 jointed, 3d bilobed, fourth minute....... *Rhynchophora.*

B. Anterior coxæ open, or closed by the epimera meeting the prosternum, epipleuræ generally distinct..... *Coleoptera* genuina.

The only apparent exceptions to this division, are the genus *Cossyphus* pointed out by Dr. Horn, and some of the *Colydiidæ*, as *Bothrideres* and *Deretaphrus*, but none of these have the characteristic tarsi; I know of nothing in the *Tetramerous* series approaching such a structure. The *Coleoptera genuina* may be thus divided:

A. Tarsi 5, 5, 4; antennæ moniliform, filiform, or serrate, not clavate.................................... *Heteromera.*

B. Tarsi variable, normally 5, 5, 5, antennæ variable. *Isomera.*

The only character to be relied on here is the tarsal joints; and undoubted Heteromerous genera occur in the *Isomera*, especially in the *Clavicornes*, as *Liodes*, etc. The antennæ are clavate in *Pentaphyllus*, *Paratenetus*, and some others; *Tetratoma* also has them strongly clavate and is probably a *Clavicorn.*

Isomera.

A. Tarsi with the 3d joint bilobed, or bifid, 4th very minute connate with the last, antennæ moniliform or filiform.. *Tetramera.*

B. Tarsi variable, generally filiform and simple...... *Pentamera.*

The characteristic Tetramerous tarsi recur in Erotylidæ, but are accompanied by a well marked antennal club, and securiform palpi; in

Dacne also this structure goes gradually out. It may be noticed also that the tarsal characters are constant in *Rhynchophora*, *Tetramera*, and *Heteromera*, all the variations by a diminished number of joints belonging to the sub-series *Clavicornes*.

PENTAMERA.

A. Ventral segments 6, 1–3 connate, 1st visible only at the sides	*Adephaga.*
B. 1st ventral segment visible in the middle.	
a. Antennæ clavate, anterior coxal cavities variable	*Clavicornes.*
b. Antennæ lamellate, cavities closed	*Lamellicornes.*
c. Antennæ serrate or filiform, cavities open	*Serricornes.*

The natural arrangement would be *Lamellicornes*, *Clavicornes*, *Adephaga*, *Serricornes.*

These groups are fairly exact; the difficulty lies between *Clavicornes* and *Serricornes*, and no clearly dividing line has yet been expressed. I think, however, that the antennæ afford a moderately good character; thus the clavate members of *Anobiidæ* and *Cleridæ* cannot be referred to *Clavicornes* as some of their closest allies are obviously pectinate, but *Cis* and *Bitoma* [*Lyctus*] seem to me undoubted *Clavicornes.*

ADEPHAGA.

A. Eyes 2, antennæ filiform.	
B. Posterior coxæ separate, anterior coxal cavities closed (except in *Trachypachys* and *Carabini*).	
C. Antennæ inserted on the front	*Cicindelidæ.*
Ca. Antennæ inserted under the front	*Carabidæ.*
Ba. Posterior coxæ contiguous.	
C. Anterior coxal cavities closed, posterior coxæ not reaching the margin	*Pseudomorphidæ.*
Ca. Cavities open, coxæ reaching the margin.	
D. Posterior coxæ large transverse	*Amphizoidæ.*
Da. Posterior coxæ very large rounded.	
E. Posterior coxæ forming a plate covering the abdomen	*Haliplidæ.*
Ea. Posterior coxæ connate with the small metasternum	*Dytiscidæ.*
Aa. Eyes two, feebly granulated, sometimes wanting; antennæ moniliform. Posterior coxæ small, sub-triangular, prominent, distant	*Rhyssodidæ.*
Ab. Eyes four, antennæ short, stout. Anterior coxæ globular	*Gyrinidæ.*

Whether the first six families would not properly be considered sub-families of Adephaga, is to me doubtful; the dividing lines break down at many points, *e. g.*, *Elaphrus* is practically a Cicindelid, and *Pelobius* is a natatorial Amphizoid. This latter is in fact most anomalous; the suture of the 2d ventral segment is obliterated in the middle so that it appears to be visible at the sides only; the posterior coxæ are quite, as in *Amphizoa*, without any trace of the large plates of the *Dytiscidæ*, the metasternum also has the transverse suture behind which is always visible in *Carabidæ*, never in *Dytiscidæ*. It will have either to be made into yet another family or will merge the others into one large family modified for terrestrial and aquatic life.

RHYSSODIDÆ.

Anterior coxæ small, globular, prominent, cavities closed.
Posterior coxæ small, sub-triangular, prominent, separate.
Ventral segments 6, 1*st visible at the side and in the middle*, 2–4 connate.
Tarsi 5-jointed, simple.

This anomalous family must be ranged in the Adelphagous series as here defined, from all members of which it is at once known by the curious posterior coxæ. The antennæ are moniliform and resemble those of Scaritidæ, to which group it is evidently allied, though it cannot be denied that it has strong apparent affinities with *Cucujidæ*. These, however, are not stronger than its analaogy to *Brenthus* and depend on a similar mode of life. The 2d ventral segment (the first is obsolete) visible at the sides and middle only, and the distinct side pieces of the thorax are characters possessed by no other Coleopterous insect out of this series. It may here be noticed that the 2d ventral segment in *Carabidæ* is often visible in the middle at the point of the ventral process, especially in *Brachynus*.

CLAVICORNES. Latr.

This large and somewhat heterogeneous group is principally characterized by the clavate or capitate antennæ; very few species being moniliform (*Cucujus*, *Rhyssodes*) and some filiform (*Staphylinidæ*). The form of the anterior coxæ will divide them into groups, according as they are conical and prominent, transverse, or small and globose; the cavities are variable, but open in the major part of the series, closed entirely in the following families, *Rhyssodidæ*, *Latridiidæ*, *Cioidæ*, *Rhizophagidæ*, *Derodontidæ*, and in almost all the genera of *Coccinellidæ*, *Colydiidæ*, *Erotylidæ*. The antennæ never show signs of being serrate, which removes the *Cleridæ* and *Anobiidæ* from the group, though some of their genera have distinctly clubbed antennæ. The number of tarsal joints is also very variable (but all with filiform tarsi 4, 4, 4, and any with a less number of joints belong here), the claws are simple except in *Coccinellidæ*, *Phalacridæ* and some *Nitidulidæ*. The accompanying table will serve to differentiate the families, and a few exceptional cases are noticed in the diagnoses of the families. This table though considerably modified, is entirely based on the admirable one given by Leconte in his classification.

CLAVICORNES.

1. Labial palpi distant at base, anterior coxæ prominent, often contiguous, claws generally dentate.......... 2
Antennæ 6–9 jointed.

— Labial palpi approximate at base.................. 3
2. Maxillary palpi elongate ; sub-aquatic.............. *Hydrophilidæ.*
— Anterior angles of thorax produced under the head in front.................................... *Leptinidæ.*
3. Anterior coxæ conical, prominent, contiguous, cavities generally open.
Claws simple, ventral segments 6–7 (rarely 5)....... 4
— Anterior coxæ ovate or globose, not prominent, very rarely contiguous, ventral segments 5, claws simple. 13
— Anterior coxæ transverse, separated, claws sometimes dentate, 2 ventral segments often connate.......... 24
4. Ventral segments 3, globose......................... *Microsporidæ.*
Ventral segments, 5–6............................. 6
Ventral segments, 7................................ 5
5. Elytra covering or nearly covering the abdomen..... *Trichopterygidæ.*
Elytra short, dorsal segments corneous.............. *Staphylinidæ.*
6. Elytra short, dorsal segments corneous, rigid........ *Pselaphidæ.*
Elytra long, 2 or 3 dorsal segments at most corneous. 7
7. Posterior coxæ contiguous.......................... 8
Posterior coxæ separate............................ 9
8. Middle coxæ oblique, simple........................ *Silphidæ.*
Middle coxæ conical prominent..................... *Brathinidæ.*
9. Tarsi 4-jointed, 3d joint minute.................... 10
Tarsi 4-jointed, filiform............................ *Tritomidæ.*
Tarsi 5-jointed.................................... 11
10. Wings fimbriate, size very small................... *Corylophidæ.*
1st ventral segment elongate....................... *Endomychidæ.*
11. Hind coxæ flat..................................... 12
Hind coxæ sulcate, sub-contiguous................. *Dermestidæ.*
12. Elytra entire, eyes coarsely granulate.............. *Scydmænidæ.*
Elytra truncate, 3 dorsal segments corneous........ *Scaphidiidæ.*

13.

13. Hind coxæ sulcate, front with an ocellus........... *Dermestidæ.*
Hind coxæ sulcate, front cavities closed............ *Derodontidæ*
Hind coxæ flat or sub-prominent.................. 14
14. Ventral segments free............................. 15
Ventral segments 1–3 connate..................... 22
15. Tarsi 3-jointed, anterior cavities closed............ *Latridiidæ.*
Tarsi 4-jointed.................................... 16
Tarsi 5-jointed or 5, 5, 4.......................... 17
16. Tarsi filiform, cavities open, ventral segments equal *Tritomidæ.*
— Tarsi simple, cavities closed, 1st ventral segment longer.. *Cioidæ.*
— Tarsi bilobed, cavities open, 1st segment longer.... *Endomychidæ.*
17. Claws simple...................................... 18
Claws dentate, 4th joint of tarsi small............. *Phalacridæ.*

18.	Antennæ 10-jointed, cavities closed................	*Rhizophagidæ.*
	Antennæ 11-jointed................................	19
19.	Tarsi deeply bilobed, maxillary palpi securiform....	*Erotylidæ.*
	Tarsi lobed beneath, 4th joint smaller..............	*Telmatophilidæ.*
	Tarsi simple......................................	20
20.	Antennæ moniliform, segments equal..............	*Cucujidæ.*
	Antennæ clavate, 1st segment elongate............	21
21.	Anterior coxal cavities open......................	*Atomariidæ.*
	Anterior cavities closed..........................	*Bitomidæ.*
22.	Tarsi 4 jointed..................................	*Colydiidæ.*
	Tarsi 5-jointed, coxæ all distant..................	*Elmidæ.*
	24.	
24.	Ventral segments 1–3 connate.....................	25
	Ventral segments free............................	28
25.	Hind coxæ sub-contiguous........................	26
	Hind coxæ separated.............................	*Elmidæ.*
26.	Tarsi 4-jointed, legs fossorial.....................	*Heteroceridæ.*
	Tarsi 5-jointed, hind coxæ sulcate.................	27
27.	Ventral segments 6–7, antennæ filiform............	*Psephenidæ.*
	Ventral segments 5, legs retractile................	*Cistelidæ.*
	Ventral segments 5, antennæ irregular............	*Parnidæ.*
28.	Tarsi 3-jointed, elytra short, truncate..............	*Micropeplidæ.*
	Tarsi 4-jointed, antennæ 9-jointed................	*Georyssidæ.*
	Tarsi 4-jointed, claws dentate.....................	*Coccinellidæ.*
	Tarsi 5-jointed, antennæ 10-jointed................	*Rhizophagidæ.*
	Tarsi 5-jointed, antennæ 11-jointed................	29
29.	Hind coxæ sub-quadrate, not reaching the margin, elytra trucate, 2 dorsal segments corneous........	*Histeridæ.*
	Hind coxæ transverse reaching the margin.........	30
30.	Tarsi generally dilated, 4th joint small............	*Nitidulidæ.*
	Tarsi simple, 1st joint short......................	*Trogositidæ.*

The family *Othniidæ* is referred as a distinct family to the Heteramera near *Lagriidæ*.

HYDROPHILIDÆ.

Anterior coxæ prominent, conical, sub-contiguous, cavities open or closed.

Posterior coxæ flat, nearly contiguous, reaching the margin.

Ventral segments 5 (occasionally 7).

Tarsi 5-jointed, posterior legs often fimbriate, claws generally dilate at base. Evidently allied to *Silphidæ* by the coxæ and increased number of segments in some species; the mentum is large, quadrate, labial palpi distant at base, maxillary palpi elongate; antennæ 6–9 jointed, side pieces of mesosternum not divided.

LEPTINIDÆ.

Anterior coxæ oval, not prominent, cavities open, no trochantin.

Posterior coxæ flat.

Ventral segments 6.

Tarsi 5-jointed, 4th oblique beneath, with a brush of hairs.

This family was founded by Dr. Leconte in the Proceedings of the Academy of Natural Sciences for 1866, and is very evidently distinct. The anterior angles of the thorax projecting under the head separate it superficially from all other Coleoptera; the regular antennæ and not prominent coxæ separate it from *Hydrophilidæ*, to which it is allied by the mentum being large and peculiar.

PLATYPSYLLIDÆ.

This extremely anomalous insect has been formed into a separate family near Leptinus by Dr. Leconte.

SPHÆRIIDÆ.

Anterior coxæ prominent exserted, contiguous, cavities open.

Posterior coxæ large, laminate, contiguous.

Ventral segments 3.

Tarsi 3-jointed.

Wings ciliate as in *Trichopteryx*, but remarkably distinct by the 3 ventral segments and facies. This family is sub-aquatic in habits, and recalls *Chætarthria* in facies.

TRICHOPTERYGIDÆ.

Anterior coxæ prominent, contiguous, cavities open or closed.

Posterior coxæ transverse, separate.

Ventral segment 6–7.

Tarsi 3-jointed.

Wings fringed with ciliæ. This family contains the smallest known Coleoptera, and is fairly uniform; the most remarkable form is *Limulodes*. Mr. Matthews in his wonderful monograph has shown as I think conclusively, that this family comes in between *Hydrophilidæ* and *Staphylinidæ*, with an additional alliance in *Leptinus*.

STAPHYLINIDÆ.

Anterior coxæ prominent, contiguous, cavities open (except some *Piestidæ*).

Posterior coxæ contiguous.

Ventral segments 7–8, dorsal segments corneous, flexible.

Tarsi variable.

This large family is rendered tolerably homogeneous by the removal of *Micropeplus*, still the *Piestidæ* with an entirely corneous prosternum and globose anterior coxæ seem to me to be anomalous, and approach rather closely to the *Cucujidæ*, but I have not had the opportunity of studying *Ino* or *Hemipeplus*.

PSELAPHIDÆ.

Anterior coxæ conical, prominent, contiguous, cavities open.

Posterior coxæ usually separate.

Ventral segments 5–6, dorsal segments corneous.

Tarsi 3-jointed, claws often unequal or single.

Elytra truncate, palpi often largely developed. This family is very unmistakeable, and is evidently a very degraded form. Eyes coarsely granulated or wanting.

SILPHIDÆ.

Anterior coxæ conical, prominent, contiguous, cavities usually open.

Posterior coxæ transverse contiguous.

Ventral segments 6.

Tarsi variable.

This family appears to me probably composite; but I have not yet been able to differentiate all its sub-divisions. *Sphærites* has only 5 ventral segments, with truncate elytra. *Leptodirus* cannot remain here, with distant posterior coxæ; *Catops* has the anterior coxal cavities more or less closed; *Anisitoma* also has the cavities closed, though the epimera are not united to the prosternum. *Clambus* is probably a family, and also *Leptodirus*. It differs from the other families with contiguous coxæ by the presence of a trochanter.

BRATHINIDÆ.

Anterior coxæ large, conical, prominent contiguous, cavities closed.

Middle coxæ also conical, prominent, contiguous.

Posterior coxæ transverse prominent, contiguous.

Ventral segments 6.

Tarsi 5-jointed, simple.

Form of *Scydmænus* but differing by the middle and posterior coxæ, and evidently forming a distinct family.

SCYDMÆNIDÆ.

Anterior coxæ conical, prominent contiguous, cavities open.

Posterior coxæ conical, distant.

Ventral segments 6.

Tarsi 5-jointed.

Eyes coarsely granulated. This family has a well defined facies.

CORYLOPHIDÆ.

Anterior coxæ ovate prominent, contiguous, cavities open, no trochanter.

Posterior coxæ distant.

Ventral segments 6.

Tarsi 4-jointed, and 3d very minute.

Wings fimbriate as in *Trichopteryx*, thorax generally produced over the head, elytra sometimes truncate behind. United by Erichson with *Coccinella*, from which it differs by the coxæ and simple claws.

SCAPHIDIIDÆ.

Anterior coxæ large, prominent contiguous, cavities open.

Posterior coxæ distant.

Ventral segments 6.

Tarsi 5-jointed, filiform.

Elytra truncate, 3 or 4 dorsal segments corneous; 5th ventral segment large. A small well defined family.

LATRIDIIDÆ.

Anterior coxæ conical, prominent separate, cavities closed.

Ventral segments 5, free, sub-equal.

Tarsi 3-jointed, simple, tibiæ without spurs.

Allied apparently to *Silphidæ* by the anterior coxæ ; separable from its allies by the 3-jointed tarsi.

DERODONTIDÆ.

Anterior coxæ conical, prominent, sub-transverse, contiguous, cavities closed.

Posterior coxæ transverse, dilated internally, protecting the thigh.

Ventral segments 5, free, equal.

Tarsi 5-jointed, 4th is somewhat smaller.

Eyes finely granulated.

Separated by Leconte from *Latridiidæ* with obvious propriety. I have provisionally placed the anomalous genus *Peltastica* in this family, it agrees in all essential characters, and it differs only in facies. The European genus *Phlœophilus* belongs here also, but has the coxal cavities open.

DERMESTIDÆ.

Anterior coxæ conical, prominent, cavities open.

Posterior coxæ transverse, dilated internally to protect the thighs.

Ventral segments 5, free, equal.

Tarsi 5-jointed, tibiæ with spurs.

Front usually with an ocellus.

This family (excluding *Trixagus*) is very homogeneous ; the prominent coxæ and free ventral segments show that it must come near *Silphidæ* ; the majority of genera are at once known by the frontal ocellus.

ENDOMYCHIDÆ.

Anterior coxæ globose, or conical, sometimes contiguous, more or less prominent, cavities open.

Ventral segments 5, first very long.

Tarsi 4-jointed, 2d emarginate, 3d hidden.

Differs from *Mycetophagidæ* by the bilobed tarsi and the long 1st ventral segment. Gerstaecker and Thomson rightly include *Mycetæa* in this family, though the tarsi simulate closely those of *Mycetophagidæ* ; the contiguous sub-conical coxæ show that its place is at this end of the series.

TRIPHYLLIDÆ.

Anterior coxæ oval, prominent, cavities open.

Ventral segments 5, equal.

Tarsi 4-jointed (♂ 3, 4, 4), filiform.

Eyes coarsely granulated.

Leconte has included *Diphyllus*, which I have removed to a separate family. Thomson adds *Tetratoma*, in which I think he is very possibly right ; certainly I do not see that genus belongs to the Heteromerous series. Geoffrony's name *Tritoma* must be restored to the typical genus *Mycetophagus*, hence I have altered the family name.

CIOIDÆ.

Anterior coxæ oval, not prominent, cavities closed.

Ventral segments 5, 1st elongate.

Tarsi 4-jointed, spurs not distinct.

Antennæ 8–10-jointed.

This family cannot belong in the *Serricornes*, which all have the coxal cavities open; it appears to me to form a distinct family near *Cryptophagidæ* and *Mycetophagidæ*, and this view is confirmed by the larvæ. It differs from the *Bostrychidæ* by the coarsely granulated eyes and distinct epipleuræ continuous to the apex of the elytra. *Endecatomus* as remarked by Leconte is an ordinary Bostrychid.

EROTYLIDÆ.

Anterior coxæ globose, separate, cavities generally closed.

Posterior coxæ transverse, not reaching the margin.

Ventral segments 5, 1st elongate.

Tarsi 5-jointed, 3d emarginate above for the 4th, which is very minute.

The coxal cavities are open in *Languria* which otherwise accords. The 4th joint of the tarsi becomes less minute in *Dacne* and *Combocerus*.

It is evident that this family must come near *Cryptophagidæ* where Thomson and Bedel place it. It has no sort of affinity with *Chrysomelidæ*. The strongly securiform maxillary palpi render most of the genera very distinct.

ATOMARIIDÆ.

Anterior coxæ small, globose, or oval, separate, cavities variable.

Ventral segments 5, equal, or with the 1st longer.

Tarsi 5-jointed (♂ sometimes 5, 5, 4), tibiæ with small spurs.

In this family I have included numerous apparently discordant elements, but which I have entirely failed to separate into distinct families. The tarsi are generally linear, lobed beneath in *Telmatophilus*, 4th joint smaller in *Silvanus*, *Psammæcus*, *Biphyllus*, *etc.*; the antennæ are 11-jointed and moniliform in *Cucujus*, generally with 3-jointed club in the rest. The basal joint of the tarsi is very short in *Cucujus*, long however in *Scalidia* and most others. The length of the ventral segments is also entirely uncertain. *Cucujus* shows an evident affinity to *Trogosita* as seen already by Thomson.

MONOTOMIDÆ.

Anterior coxæ small, rounded, separate, cavities closed.

Ventral segments 5; 1 and 5 elongate.

Tarsi 5-jointed, 4th narrower, 5th elongate.

Elytra truncate, last dorsal segment visible, eyes strongly granulated, antennæ 10-jointed, club abrupt.

This family was founded by Leconte, and as I think, with reason. The structure of the antennæ, the 6th dorsal segment in the ♂ and the facies all show great affinity to *Rhizophagus*, from which the anterior coxæ at once separate it. Thomson has placed them in *Latridiidæ*, which the 5-jointed tarsi prevent; Duval with the *Cucujidæ* on account of the short 1st joint of the tarsi. The raised line on the 1st ventral segment and the structure of the head show a close affinity to *Silvanus*.

BITOMIDÆ.

Anterior coxæ rounded, cavities closed.

Ventral segments 5, 1st elongate.

Tarsi 5-jointed, 1st joint extremely minute.

This family was formed by Duval, who included *Endecatomus*, which is however a true *Bostrychide* as shown by Leconte; Thomson has left *Lyctus* also in *Bostrychidæ*, but it agrees in all essentials with *Colydiidæ* and *Cucujidæ*, having a close affinity to the latter by the short 1st joint of the tarsi. The name *Lyctus* was first used for this genus by Latreille in 1807, but Herbst had previously indicated it and in the name *Bitoma* in 1794. Wollaston dissected this genus carefully in 1854, and considered it a Colydiid, regarding the basal articulation as merely a swelling; it appears to me certainly very close to *Colydiidæ* by the structure of the prosternum, the club, and the obsolete elytra epipleuræ, but the basal joint is visible is some species.

COLYDIIDÆ.

Anterior coxæ small, globular, cavities generally closed.

Posterior coxæ sometimes contiguous, transverse.

Ventral segments 5, 1–3 or 1–4 connate; 1st often elongate.

Tarsi 4-jointed, simple.

Antennæ often capitate, form cylindrical, or depressed and with gradually clavate antennæ. Eyes coarsely granulated. The prosternal structure in *Bothrideres* resemble that of *Brenthus* and also of *Rhyssodes*. *Myrmecoxenus* must be placed here according to Thomson, having the 4-jointed tarsi and connate segments, but he also adds *Silvanus*, in which I cannot concur. He breaks the family up into three, *Bothrideridæ*, *Colydiidæ*, *Synchitidæ*. *Murmidius* if not a separate family can only go here; the globose anterior coxæ and 4th-jointed tarsi would seem to agree very well. After examining *Discoloma* and other genera, it is evident that *Cossyphus* can only go here (or in a separate family next to it, characterized by the heteromerous tarsi).

RHIZOPHAGIDÆ.

Anterior coxæ ovate or rounded, cavities generally transverse, always closed.

Posterior coxæ transverse.

Ventral segments 5, 1st elongate, often with coxal lines.

Tarsi 5-jointed, often dilated.

Antennæ 10-jointed, 11th joint connate with the preceding.

This family is identical with *Monotomidæ*, *etc.*, except that I have added

Rhizophagus; it thus makes a very natural family with a distinct facies, and identical structure. The coxal cavities vary from transverse to rounded by imperceptible degrees.

TROGOSITIDÆ.

Anterior coxæ transverse, separate, cavities variable.

Posterior coxæ transverse reaching the margin.

Ventral segments 5, equal.

Tarsi 5-jointed, not dilated.

Peltastica, placed provisionally here by Leconte, I have removed to *Derodontidæ*. This family contains two very different types; the elongate narrow *Trogosita* placed by Thomson near *Cucujus* on account of the very minute 1st tarsal joint and less transverse cavities; and the broad species of *Ostoma* (Peltis) which are like *Nitidula*, except that the tarsi are not dilated.

NITIDULIDÆ.

Anterior coxæ transverse, cavities generally closed.

Posterior coxæ distant, almost reaching the margin.

Ventral segments 5.

Tarsi 5-jointed, dilated, 4th joint small, claws sometimes dentate.

The capitate antennæ are generally characteristic of this group; the coxal cavities are open in *Cychramus*, *Ips.*, *etc.*; *Byturus* is better here by the dentate claws than in *Dermestidæ*, though the lobed tarsi are distinctly anomalous; Kiesenwetter and Thomson place it here; Duval places it with *Telmatophilus*, which seems impossible. *Rhizophagus* is excluded by Murray, but is osculant between this family and *Trogositidæ*. The small genera *Hesperobænus*, *Bactridium*, *Europs* and *Nomophlœus* must come here as the cavities are made precise, as in *Rhizophagus*; *Phyconomus* also has dilated tarsi.

MICROPEPLIDÆ.

Anterior coxæ transvere, cavities closed.

Posterior coxæ distant, rounded.

Ventral segments 6.

Tarsi 3-jointed.

Antennæ 9-jointed, with an abrupt club, received into thoracic cavities.

Elytra truncate, short.

This family is very anomalous, but its whole relationship is with *Nitidulidæ*, having no character in common with *Staphylinidæ* except the short elytra. The discovery of the larva also confirms this view.

PHALACRIDÆ.

Anterior coxæ small, globose, separate, cavities open.

Posterior coxæ contiguous, not reaching the margin.

Tarsi 5-jointed, 4th very small, claws dentate.

Allied to *Nitidulidæ* by the claws and tarsi, but differing by the anterior and posterior coxæ, it must, however, evidently be placed next them.

COCCINELLIDÆ.

Anterior coxæ transverse, cavities generally closed.

Posterior coxæ distant, not reaching the margin, sometimes sulcate.

Ventral segments 5–6 (7 in *Hyperaspis* ♂).

Tarsi 4-jointed, 2d bilobed, 3d very minute, claws generally dentate.

The structure of the tarsi has generally caused these insects to be placed at the end of the order, but they evidently belong in the *Clavicorn* series, from all other families of which they differ by their tarsi, combined with securiform palpi, generally dentate claws and usually closed cavities. The only other family with similar tarsi is the *Endomychidæ*, which has small globose anterior coxæ, with open cavities and simple claws. It is, however, to be noticed that the elongate aberrant *Coccidula* has sub-globose anterior coxæ. The coxæ are often sulcate as in *Cistelidæ*.

CISTELIDÆ.

Anterior coxæ transverse, cavities open.

Posterior coxæ sub-contiguous, reaching the margin.

Ventral segments 5, 1–3 sub-connate.

Tarsi 5-jointed, often lobed beneath.

Antennæ gradually clavate, legs retractile, hind coxæ sulcate.

This family is very distinct by its facies. *Chelonarium* may form a separate family, the antennæ are entirely filiform. I have reverted here, as elsewhere, to Geoffrony's name for the typical genus (1762); the name *Byrrhus* belongs to the *Anobium*, Fabr., and the *Byrrhus* of Linnæus is *Anthrenus*, Geoff. By means of *Liminichus* this family is closely allied to *Georyssus* and *Elmis*.

GEORYSSIDÆ.

Anterior coxæ compressed, trochanters large, covering the prosternum, cavities open.

Posterior coxæ distant.

Ventral segments 5, 1st very large, 1–2 connate.

Tarsi 4-jointed, antennæ 9-jointed.

Allied to *Cistelidæ* (*Byrrhidæ*) by the general habit; distinct.

PSEPHENIDÆ.

Anterior coxæ globular, cavities open, prolonged externally, trochanter very large.

Posterior coxæ dilated into a plate, contiguous.

Ventral segments 6–7, 1–2 connate.

Tarsi 5-jointed.

Maxillary palpi very long, securiform, antennæ long, filiform. This insect is most singular and anomalous; notwithstanding the evident affinity to *Parnidæ* it differs remarkably from it by the elongate palpi and 6 ventral segments. The 7th ventral segment is visible only in the ♂. It is in many respects closely allied to *Helodes* in the *Serricornes*. This family is the commencement of a small group of closely allied families, differing in the details of the coxæ, but agreeing remarkably in the parts of the mouth.

PARNIDÆ.

Anterior coxæ transverse, cavities open, trochanter distinct.

Posterior coxæ dilated into a plate, contiguous.

Ventral segments 5, 1–3 connate.

Tarsi 5-jointed.

Antennæ short irregular, as in the *Gyrinidæ*, to which this family is evidently allied, though differing remarkably in the form of the coxæ. Leconte's two sub-families entirely destroy the homogeneity of this family and are made into separate families.

ELMIDÆ.

Anterior coxæ small, rounded, without trochanter, cavities open.

Posterior coxæ transverse, distant.

Ventral segments 5, 1–3 connate.

Tarsi 5-joined, 5th elongate.

Allied to *Parnidæ* by mode of life, and more or less by the appearance of the larvæ; but remarkably distinct structurally. Antennæ short, hardly sub-clavate. The tarsal structure is very like *Hydrochus* but the broadly distant coxæ entirely remove it.

HETEROCERIDÆ.

Anterior coxæ transverse, cavities open.

Posterior coxæ sub-contiguous.

Ventral segments 5, 1–3 connate.

Tarsi 4-jointed.

Antennæ 10–11-jointed short, irregular. Evidently allied to *Parnidæ*, but with a very characteristic facies.

HISTERIDÆ.

Anterior coxæ transverse, cavities open.

Posterior coxæ distant, sub-quadrate, not reaching the margins.

Ventral segments 5, 1st very large.

Tarsi 5-jointed (*Acritus* 5, 5, 4), legs retractile.

Differs from the other families by the geniculate antennæ, with a compact rounded club; elytra truncate, 2 dorsal segments uncovered, corneous. *Murmidius*, placed here by Dr. Leconte, seems to me certainly an aberrant form of *Colydiidæ*.

The two families of *Lamellicornes* are easily distinguished. The *Serricorn* series also is well arranged by Leconte. The *Tetramera* include only 3 families, *Cerambycidæ*, *Bruchidæ*, *Chrysomelidæ*, and their limits are hard to define. The *Heteromera* have been divided by Leconte into convenient families; possibly *Lagria* and *Allecula* (*Cistela*) should go in *Tenebrionidæ* and certainly *Nilio* should go with *Pythidæ*, bearing as Dr. Horn has suggested to me, the same relation to it as *Thymalus* does to *Trogositidæ*. The *Rhynchophorus* families are still doubtful, probably there are only three, *Anthribidæ*, *Curculionidæ* and *Scolytidæ*.

REVISION OF THE SPECIES OF SEVERAL GENERA OF MELOIDÆ OF THE UNITED STATES.

By George H. Horn, M. D.

(Read before the American Philosophical Society, February 21, 1873.)

The genera reviewed in the following pages are Macrobasis, Epicauta, Cantharis and Pomphopoea, which comprise the large majority of the species of Meloidæ in our fauna. The other genera have not been noticed on account of either of the fewness of the species contained in them, or from the lack of sufficient material to determine correctly the relationship of the species. In the latter case may be cited, Meloe and Nemognatha, especially the former, of which probably, the majority of the species have been described from unique specimens. The attention of all collectors is called especially to the species of Meloe, and at the same time an accurate determination of the sexes is more than all desirable. The species of Pyrota are also well worthy of attention, and it is probable that some of them, especially those in the banded group, will have to be suppressed when further material shall have been collected.

Macrobasis. Lec.

Macrobasis, Lec. Class. Col. N. A. p. 272; *Apterospasta*. ibid.

The genus Macrobasis, with which I am compelled to unite *Apterospasta*, differs from Epicauta by characters of comparatively trifling moment. The first joint of the antennæ of the male is elongate, in a part of the species very greatly, and in an equal number, moderately so. In the former case the first joint frequently equals twice the length of the two following together, and in the latter is about equal to them. The second joint of the antennæ of the male is always more than half the length of the third, and sometimes greatly longer than that joint. From the variability of the antennæ it may be seen, that there is very great difficulty in separating the genus from *Epicauta*, and it is very doubtful if the advancement of science would be at all retarded by their union. *Apterospasta* is certainly not distinct, the presence or absence of wings being rather specific than generic, and the type of the genus is moreover strongly winged. The species of *Macrobasis* may be separated by their sexual characters and the scheme thus produced contains at the head those species the most remote by their antennal characters from *Epicauta*, and thence gradually approaching that genus.

A. First joint of antennæ male very elongate, usually more or less dilated at tip and contorted, and always longer than the two following joints together.

- Anterior tibiæ ♂ with two terminal spurs............. *albida.*
- Anterior tibiæ ♂ with a single terminal spur.
  - Second joint of antennæ ♂ frequently shorter than the third alone.
    - First joint anterior tarsi ♂ longer than second and normal; legs black.
      - Elytra uniformly cinereo-pubescent............. *longicollis.*
      - Elytra cinereo-pubescent, with two broad black stripes on each.............................. *atrivittata.*
    - First joint ant. tarsi ♂ shorter than second and oblique prolonged; legs pale.
      - Antennæ with joints 2–11 ♂ stout, conical; elytra luteous, finely cinereo-pubescent.......... *ochrea.*
      - Antennæ with joints 2 and 3 ♂ stout, 4–11 slender; elytra piceous, cinereo-pubescent, with a fine more densely pubescent line........ *virgulata.*
  - Second joint of antennæ ♂ longer than the third and fourth together.
    - Anterior tarsi male with one terminal spur........ *torsa.*
- B. First joint of antennæ ♂ moderately elongate, never longer than the second and third together and never contorted at tip.
  - Second joint antennæ ♂ long, equal to third and fourth together.
    - Anterior tibiæ ♂ with two terminal spurs.......... *unicolor.*
    - Anterior tibiæ ♂ with one terminal spur........... *tenuis.*
  - Second joint antennæ ♂ not much longer than third alone.
    - Body cinereo to fulvo-pubescent; winged.......... *immaculata.*
    - Body entirely black above.
      - Body sometimes with wings well developed, usually feebly developed................................ *segmentata.*

M. albida, Say. Journ. Acad. III, p. 305; *luteicornis*, ♂ Lec. Proc. Acad. VII, p. 84. Black, densely cinereo-pubescent, varying to pale ferruginous. Head black, epistoma and labrum pale luteous, a small smooth space near the insertion of the antennæ and a smooth median line not attaining the occiput, surface densely punctulate and pubescent. Antennæ and palpi pale luteous, glabrous. Thorax slightly longer than wide, sides nearly parallel behind, in front arcuate and narrower to apex, disc moderately convex, usually with an elongate narrow space on each side clothed with black pubescence, surface densely punctate and pubescent. Elytra broader than the thorax and gradually broader behind, surface densely punctulate and pubescent, humeri with linear black spot. Body beneath densely pubescent. Legs black, densely pubescent. Knees outer edge of tibiæ and all the tarsi with black pubescence. Length .88—1.00 inch; 22–25 mm.

Male. First joint of antennæ nearly as long as the head, flattened and gradually thicker to tip and sinuate on the anterior margin near the tip; second joint longer than the third and equal to the fourth. Sixth abdominal segment feebly emarginate at tip. Antennæ at base smooth very sparsely punctured.

Female. First joint of antennæ not flattened, slightly thicker at tip, punctured and pubescent, joints 2–11 sub-equal. Sixth abdominal segment sub-truncate.

The characters of the table and those above will readily enable this species to be separated from all those which it most closely resembles in general appearance. Abundant in Texas.

M. longicollis, Lec. Proc. Acad. 1853, p. 343.

Closely resembles the preceding species and differs superficially in having the antennæ and parts of mouth entirely black, the thorax without the discal narrow black spaces and the humeral spot longer. It differs especially in its sexual characters. Length .80—.90 inch ; 20–23 mm.

Male. Antennæ with first joint as long as the head, flattened, very feebly sinuate at anterior margin near the tip, sparsely punctured, joints 2 and 3 sub-equal. Abdomen as in *albida.* Anterior tibiæ with one spur. Inferior edge of femora glabrous.

Female. Antennæ with first joint less than half the length of head, slightly flattened, punctured and pubescent, second joint slightly shorter than third and nearly equal to fourth. Anterior tibiæ with two spurs. Inferior edge of femora pubescent. Occurs in Texas, Arizona and New Mexico.

M. atrivittata, Lec. Proc. Acad. 1854, p. 224.

More elongate than the preceding species and differing in the surface vestiture, as follows: Head pubescent with black, a small white anteocular space and median narrow line cinerous. Antennæ and parts of mouth black. Thorax cinereo-pubescent with a large black space at middle, divided by fine median cinereous line. Elytra pubescent with black, suture narrowly, apex and sides more broadly cinereo-pubescent, and a moderately broad cinereous vitta extending from the humerus and not attaining the apex. Body beneath cinereo-pubescent, at the sides black, abdomen black apices of segments cinereo-pubescent. Legs black, outer side of femora cinereo-pubescent. Length .70–1.28 inch ; 18–32 mm.

Male. First joint of antennæ flattened, broadly dilated at tip and obliquely truncate at tip, longer than the head, shining and sparsely punctured, second joint stout, broader than long and longer than either the third or fourth, third joint small, shorter than the fourth which is also stout and half the length of the fifth ; joints 5–11 robust but elongate. Terminal joint of labial palpi disciform. Anterior tibiæ with one terminal spur. Sixth abdominal segment broadly emarginate at tip. Inferior edge of femora glabrous.

Female. First joint of antennæ half the length of head, flattened and gradually broader to tip, more distinctly punctulate than the male, joints 2–11 sub-equal and gradually more slender to tip. Last joint of labial palpi broadly triangular. Anterior tibiæ bicalcarate. Femora pubescent beneath. Sixth abdominal segment sub-truncate. Occurs in Texas and Arizona.

M. ochrea, Lec. Proc. Acad. 1853, p. 342.

Pale testaceous, sparsely clothed with pale luteous pubescence. Form similar to *albida.* Head moderately punctulate and sparsely pubescent. Antennæ with basal joint luteous, outer joints piceous. Thorax feebly convex, densely punctulate with smooth fine median line. Elytra finely punctate, sparsely pubescent. Body beneath and legs similar to the upper surface. Length .65 inch ; 16 mm.

Male. First joint of antennæ longer than half the head, arcuate, gradually broader to tip, flattened and obliquely truncate, joints 2–11 subequal, stout and obconical. Lower edge of femora glabrous. Anterior tibiæ with one spur. First joint of anterior tarsi broad, obliquely prolonged, concave above and shorter than the second. Sixth abdominal segment broadly emarginate at tip. Last dorsal segment moderately prolonged and notched at tip.

Female. Unknown.

Collected at New Braunfels, Texas.

M. virgulata, Lec. New Species, 1866, p. 156.

Piceous, sparsely cinereo-pubescent. Form similar to *albida* but more slender and very much smaller. Head moderately punctured, with fine median smooth line and sparsely pubescent. Thorax moderately punctured, sparsely pubescent and with fine smooth median line. Elytra punctate scabrous, sparsely pubescent, with a denser line of pubescence at the middle of each elytron. Body beneath piceous, sparsely punctulate and pubescent. Legs pale testaceous. Length .34–.40 inch ; 9–10 mm.

Male. First joint of antennæ nearly as long as the head, moderately arcuate, flattened and sinuately emarginate near the tip ; second joint smaller than the third and the two together equal to the fourth ; joints 4-11 sub-equal gradually more slender to tip. Femora beneath glabrous at base. Anterior tibiæ with one terminal spur. Anterior tarsi with first joint shorter than second, slightly obliquely prolonged and somewhat concave above. Sixth abdominal segment broadly emarginate.

Female. First joint of antennæ not half as long as the head, slightly arcuate and somewhat broader to tip, joints 2–3–4 gradually longer, 4–11 sub-equal. First joint anterior tarsi longer than the second and not deformed. Femora pubescent. Sixth abdominal segment sub-truncate.

Collected at Cape San Lucas.

M. torsa, Lec. Proc. Acad. 1853, p. 343.

Black, sub-opaque, sparsely cinereo-pubescent. Head moderately densely punctulate. Antennæ black. Thorax slightly broader than long, sides behind nearly parallel, at apex arcuately narrowed, median line moderately impressed, surface opaque, sparsely punctulate. Elytra elongate, sub-parallel, moderately punctured, sparsely and finely cinereo-pubescent with pruinose aspect. Body beneath and legs black, somewhat more densely pubescent than the upper surface. Length .44–.60 inch; 11–15 mm.

Male. First joint of antennæ nearly as long as the head, flattened and nearly sigmoid in form, second joint as long as the two following together, third shorter than the fourth, joints 4–11 very gradually longer and slender. Anterior tibiæ with one spur. First front tarsal joint not longer than the second. Lower margin of femora glabrous.

Female. First joint of antennæ half the length of head, second slightly longer than third, joints 3–11 sub-equal. Middle and hind femora pubescent beneath, anterior tibiæ bicalcarate.

Resembles *tenuis* and *unicolor*, but the table shows the more remarkable points of difference.

Occurs in Texas.

M. unicolor, Kby. Fauna. Bor. Am. p. 241; *cinerea*, Fab. Ent. Syst. Suppl. p. 119; Harris, Bost. Journ. 1, p. 497; *Fabricii*, Lec. Proc. Acad. 1858, p. 343; *murina*, Lec., *debilis*, Lec. loc. cit. p. 344.

The name *Fabricii* is dropped for the following reasons, viz.; if *Macrobasis* be a valid genus the name *cinerea* is not preoccupied, and should *Macrobasis* be merged in *Epicauta* then *unicolor* Kby. has priority.

Very similar in form to the preceding, but has usually a more cinereous aspect from the denser pubescence. The sexual characters furnish the greater points of difference. Length .32–.64 inch; 8–16 mm.

Male. First joint of antennæ shorter than the head, slightly broader toward the tip, slightly flattened and very feebly arcuate, second longer than the two following joints together, joints 3–11 gradually but very slightly longer. Anterior tibiæ bicalcarate. Lower edge of femora pubescent beneath.

Female as in the preceding species.

The species known as *murina* and *debilis* appear to be merely badly developed forms and not entitled to rank as species. *M. unicolor* differs from *torsa* and *tenuis* in the male, having two spurs to the anterior tibiæ.

A very widely distributed species, occurring from Canada to Kansas and to Georgia and Arizona.

M. tenuis, Lec. Proc. Acad. 1858, p. 343.

More elongate than *unicolor* and clothed with whiter and more lustrous pubescence. Epistoma, labrum and palpi testaceous at least in the male. Length .62 inch; 16 mm.

Male. First joint of antennæ nearly as long as the head, formed as in *unicolor*, second joint nearly as long as the three following together, joints 3–11 sub-equal. Anterior tibiæ with a single terminal spur. Femora pubescent beneath.

Female. Not known with certainty.

One male from Georgia.

M. immaculata, Say. Jour. Acad. III, p. 301; *articularis*, Say, ibid; *fulvescens*, Lec. Proc. Acad. 1858, p. 447.

Black, densely clothed with pubescence varying in color from ferruginous to cinereous. Form and sculpture very closely resembling *albida*. Disc of thorax and elytral humeri concolorous. Body beneath clothed as on the upper surface. Legs as in *albida*. Length .50–.90 inch; 13–23 mm.

Male. First joint less than half the length of head, feebly flattened and not contorted at tip, second joint cylindrical, slightly longer than half the first, and somewhat shorter than third, joints 3–11 sub-equal and gradually more slender to tip. Anterior tibiæ bicalcarate. Femora entirely pubescent beneath. Sixth abdominal segment feebly emarginate at tip.

Female. Antennæ scarcely differing from the male, but with the basal joints more slender. Sixth abdominal segment sub-truncate.

The thorax of this species is rather shorter than *albida* or *longicollis* which it most resembles, but for their separation the sexual characters as given in the table must be relied on.

Not rare in Kansas, Colorado and Texas.

M. segmentata, Say. Journ. Acad. III, p. 308; Lec. Proc. Acad. 1853, p. 342; *valida*, Lec. Journ. Acad. IV, 1858, p. 39.

Body above entirely black, clothed with short black pubescence. Head feebly shining densely punctulate. Thorax nearly as broad as long, sides in front arcuate to apex, disc moderately convex, median line feebly impressed in front, more deeply and broadly impressed at base, surface densely punctulate, sparsely pubescent with black, and with the apical and basal margins fimbriate with short cinereous hairs. Elytra scarcely broader at base than thorax and gradually broader behind, surface subopaque, finely scabro-punctate and sparsely clothed with short black hairs. Body beneath black, more shining than above, punctulate and pubescent with short black hairs, the coxæ and apices of the abdominal segments margined with short white pubescence. Legs entirely black, densely punctulate and sparsely pubescent. Length .52–.92 inch; 13–23 mm.

Male. First joint of antennæ shorter than half the head, slightly thicker externally and feebly flattened, second half the length of first and slightly shorter than the third, fourth shorter than third and equal to second, joints 4–11 sub-equal and gradually more slender to tip. Sixth abdominal segment feebly emarginate.

Female. Antennæ not differing in form from the male and somewhat more slender. Sixth abdominal segment somewhat sub-truncate.

This species is usually very feebly winged, the wings being very small and rudimentary, specimens however occasionally occur with the wings as well developed as in the other Macrobases, and in no other respec differing from the other individuals. The abdominal segments beneath are rarely entirely black. *M. valida* Lec. does not appear to differ in an other respect than in being larger than the forms found in Kansas an recognized as the typical forms of the species.

Occurs from Kansas to Texas and Arizona.

Of the following species we possess females only and their prope places cannot therefore be assigned them in accordance with the character made use of in the table at the beginning of the genus. They are a follows :

M. sublineata, Lec. Proc. Acad. 1853, p. 447.

Form similar to *albida*. Head black, densely punctulate and densely cinereo-pubescent. Thorax slightly longer than wide and widest slightly in front of middle, sides in front obliquely narrowed, disc feebly convex, dorsal channel obliterated in front, shallow at base, surface punctulate and pubescent. Elytra black, finely punctato-scabrous, apex cinereo-pubescent, remainder of surface with cinereous and black pubescence intermixed, and with three very fine lines of totally black hairs. Body beneath black, densely cinereo-pubescent. Length 1.05 inch ; 26 mm.

Male unknown.

Female. Antennæ of same form as in *longicollis*. From the structure of the antennæ of the unique before me, it is probable that were the male known its position would be near *longicollis*.

One female from Texas.

M. tenella, Lec. Journ. Acad. IV, 1858, p. 23. Head pale yellowish testaceous, moderately shining, very sparsely punctured and sparsely cinereo-pubescent. Thorax colored as the head, longer than wide, narrower than the head, surface rather densely punctured and sparsely pubescent. Elytra black, punctured, sparsely pubescent with cinereous hairs. Body beneath piceous, mesosternum and tip of abdomen pale rufo-testaceous. Legs pale rufo-testaceous. Length .48 inch ; 12 mm.

Antennæ pale testaceous, first joint one-third the length of head, scarcely broader to apex and feebly flattened, second joint longer than half the first, third slightly longer than the second, fourth equal to second, joints 4–11 sub-equal and slender.

I cannot determine with certainty the sex of the specimens before me, as they are so injured at the tip of the abdomen as to be unfit for determination. The characters given serve to distinguish it from all the other species in the genus. In the list it appears as an Epicauta.

Collected by Captain Pope, on the Staked Plain of Texas.

M. linearis, Lec. Journ. Acad. IV, 1858, p. 23.

Form slender, elongate. Head piceo-testaceous, moderately shining, punctulate and sparsely cinereo-pubescent. Thorax narrower than the head, one-fourth longer than wide, sides behind parallel, anteriorly obliquely narrowed to the apex, color piceous, surface moderately shining, punctured, sparsely cinereo-pubescent and with fine smooth median line. Elytra luteous, finely punctate-scabrous and sparsely cinereo-pubescent.

Body beneath and legs piceous, moderately shining, sparsely punctured and cinereo-pubescent. Length .46 inch; 12 mm.

Resembles *virgulata* in form and in the structure of the antennæ of the female. The discovery of the male is necessary to determine its position with certainty.

One female, Staked Plain, Texas.

EPICAUTA. Fab.

This genus is closely allied to *Macrobasis* and differs in having the first joint of the antennæ usually shorter, rarely equal to, and never longer than the third; the second joint is never greater in length than half the third. These characters apply equally well for both sexes.

The species are moderately numerous in our fauna, and may be divided for convenience of study in the following manner:

A. Antennæ similar in thickness throughout, joints cylindrical and closely articulated. Eyes prominent, coarsely granulated, feebly or not emarginate in front and nearly as wide as long.
Pubescence sparse, black and erect.
Head and thorax very sparsely punctured and with shining surface.............................. *oblita.*
Head and thorax densely punctured and less shining. *puncticollis.*
Pubescence usually dense, always recumbent, and generally cinereous, ferruginous or fulvous, sometimes nearly black.
Head less densely punctured than the thorax; thorax longer than wide...................... *convolvuli.*
Head and thorax similarly punctured.
Thorax longer than wide...................... *strigosa.*
Thorax as wide as long.
Surface of thorax equally punctured.
Pubescence dense concealing the surface color.
Thorax moderately shining, rather coarsely and densely punctured.................. *ferruginea.*
Thorax opaque, more finely and densely punctured.............................. *sericans.*
Pubescence short, sparse; facies pruinose.... *pruinosa.*
Thorax with a smooth slightly elevated space on each side.................................... *callosa.*

B. Antennæ scarcely more slender to tip, joints cylindrical.
Eyes narrow, emarginate in front, very finely granulated, not prominent.
Vertex and occiput longitudinally broadly concave. *caviceps.*

C. Antennæ always more slender to the tip, joints loosely articulated and always more or less compressed. Eyes always longer than wide (usually twice as long as wide), emarginate in front, less coarsely granulated than in A, and less prominent.

- Anterior tibiæ ♂ with a single terminal spur.
  - Legs rufous, elytra uniformly pubescent.......... *pedalis.*
  - Legs black, elytra cinereo-pubescent with denuded spots.
    - Maxillary palpi ♂ normal, elytral spots, large, smooth.................................... *pardalis.*
    - Maxillary palpi ♂ with last joint broadly dilated, elytral spots not confluent, opaque and punctulate.. *maculata.*
- Anterior tibiæ ♂ with two terminal spurs.
  - Elytra vittate, head broader than thorax, thorax longer than wide.
    - Elytra pale luteous, with two black stripes...... *vittata.*
    - Elytra pale luteous, with three black stripes.... *lemniscata.*
  - Elytra not vittate, surface (less the pubescence) unicolored.
    - Legs pale rufous, elytra pale brown, finely cinereo-pubescent................................ *nigritarsis.*
    - Legs black, elytra black (less the pubescence).
      - Body beneath with moderately long yellowish red pubescence.
        - Elytra black, entire margin and transverse band with reddish pubescence............. *Stuarti.*
      - Body beneath with short pubescence, either cinereous or black.
        - Thorax with reddish pubescence, elytra cinereo-pubescent.......................... *Wheeleri.*
        - Thorax with cinereous or black pubescence.
          - Body cinereo-pubescent beneath........... *cinerea.*
          - Body totally black, above and beneath.
            - Middle and hind femora ♂ normal.
              - Spurs of hind tibiæ stout, similar *funebris.*
              - Spurs of hind tibiæ slender and acute at tip.
                - Surface opaque, pubescence rather coarse............... *fissilabris.*
                - Surface velvety, pubescence very fine.................. *corvina.*
              - Spurs of hind tibiæ dissimilar, outer spur broader; surface opaque, pubescence coarse.... *pensylvanica.*
            - Middle and hind femora ♂ with lower face broad, smooth, slightly concave longitudinally, and fimbriate on the margins.
              - Spurs of hind tibiæ slender........ *maura.*

A.

E. puncticollis, Mann. Bull. Mosc. 1843, p. 288; Lec. Ann. Lyc. V, p. 162; Proc. Acad. 1853, p. 338.

Black, moderately shining; sparsely clothed with erect black pubescence. Head coarsely and moderately densely punctured. Thorax slightly longer than wide, sides in front moderately arcuate, surface moderately shining, coarsely and rather densely punctured. Elytra coarsely punctato-scabrous. Body beneath more shining than above and more sparsely punctured. Length .30–.50 inch; 8–13 mm.

Occurs abundantly from Oregon to San Diego, Cal.

E. oblita, Lec. Ann. Lyc. V, p. 162; Proc. Acad. 1853, p. 339.

Very closely allied to the preceding species and differs by its rather more slender form and much less densely punctured head and thorax, although the punctures are equally coarse in both species. The antennæ also show a tendency to become more slender toward the tip, but this character is more than compensated by the broad eyes, this being especially the character of the group. Length .30–.40 inch; 8–10 mm.

Occurs at San Francisco, Cal., and also in Owen's Valley.

E. convolvuli, Mels. Proc. Acad. III, p. 53; Lec. ibid, 1853, p. 339; Lec. New Species, p. 157.

Black, opaque, densely punctulate, clothed with short moderately dense recumbent pubescence. Head behind the eyes red, vertex finely canaliculate. Thorax narrower than the head, and more densely punctured, one-half longer than wide, a fine median line. Elytra moderately elongate, surface granulato-scabrous. Length .30–.50 inch; 8–13 mm.

Male. Head opaque, punctures less deep and less numerous. Terminal abdominal segment slightly emarginate.

Female. Head shining, punctures coarse and more densely placed. Terminal segment rounded at tip.

In the majority of specimens the head behind the eyes is red, but in many the head is intensely black and sometimes attains an unusually large size. The pubescence of the entire surface is usually cinereous varying from this to an almost entire blackness. In the latter case the species resembles *E. pensylvanica,* from which it may be distinguished by the form of the eyes and antennæ as well as by the punctuation of the head and thorax being dissimilar.

Occurs from Pennsylvania to Texas.

E. strigosa, Sch. Syn. Ins. III, App. p. 18; Lec. Proc. Acad. 1853, p. 341; *nigricornis,* Mels. Proc. Acad. III, p. 53.

Body black. Head densely punctured, at middle finely canaliculate, clothed with cinereous or ferruginous pubescence. Thorax longer than wide, feebly narrowed to the front, surface densely punctured, densely clothed with cinereous or ferruginous pubescence with a dark line on each side of middle. Elytra finely punctato-scabrous, clothed similarly to the thorax and with a moderately broad black vitta near the suture and another near the side. Body beneath and legs black, densely punctulate, more shining than the upper surface and sparsely cinereo-pubescent. Length .26–.40; 7–10 mm.

The form above described in which the thorax has the two black spaces on the disc and the elytra each with two black lines, is that which is most commonly seen; from this the elytra may become almost entirely black or entirely ferruginous. The totally black forms resemble *E. pensylvanica* and the ferruginous *E. ferruginea*. The form of the eyes and antennæ distinguish it from the former, and the form of the thorax from the latter.

Occurs from Pennsylvania to Georgia.

E. ferruginea, Say. Journ. Acad. III, p. 298.

Black, densely clothed with cinereous, luteous or ferruginous pubescence. Head shining, moderately punctured. Thorax slightly wider than long, broadly sub-campanulate, sides in front arcuate, surface shining, coarsely but not densely punctured. Elytra finely scabro-punctate. Body beneath black, shining, moderately punctured, sparsely pubescent. Length .12–.36 inch; 3–9 mm.

The forms with paler vestiture resemble *E. sericans*, but the thorax is more coarsely and less densely punctured and more shining, and the pubescence coarser and less dense. The species here described is not that of Leconte (Proc. Acad. 1853, p. 341), which is merely the ferruginous variety of the preceding species. Say's type was collected on the Plains west of the Mississippi, and doubtless is the one here described. It is one of the most abundant species of the region indicated, extending from Dacota to New Mexico.

E. sericans, Lec. New Species, p. 158; ? *immerita*, Walker, Nat. Brit. Col. II, p. 330.

Black, rather densely clothed with cinereous pubescence tending in color to luteous. Head densely and finely punctured. Thorax as wide as long, sides in front broadly arcuate to apex, surface sub-opaque densely and finely punctured. Elytra densely punctato-scabrous. Body beneath more shining than above, less densely punctulate. Length .30–.50 inch; 8–13 mm.

The specimens with the ferruginous pubescence resemble the preceding species, but may be at once distinguished by the much more dense punctuation of the head and thorax.

Occurs abundantly from Kansas to New Mexico and Oregon.

E. pruinosa, Lec. New Species, p. 158.

Similar in form to the preceding, and differs in the pubescence being very short, sparse, white and not concealing the surface but merely giving it a pruinosa aspect. The punctuation of the surface is also much finer and less dense. Length .30–.50 inch; 8–12 mm.

Occurs with the preceding species, but not farther west than Utah.

E. callosa, Lec. New Species, p. 158.

In sculpture resembles *E. ferruginea*, and differs in this respect only in having on each side of the median line a small smooth callus. The pubescence is, however, coarser and fulvous. Length .40-.50 inch; 10-12 mm.

Occurs from Dakota to Texas.

The pubescence is very fine and very apt to be lost, in which case the surface color alone appears and the species becomes totally black.

B.

E. caviceps, nov. sp.

Black, moderately shining, sparsely clothed with fine whitish pubescence. Head black, fine, punctulate, vertex and occiput broadly concave; eyes very narrow, scarcely one-third as wide as long; antennæ scarcely more slender to tip and nearly half as long as the body. Thorax broadly oval, sides arcuate and gradually narrowed to apex, surface moderately convex, feebly shining, and minutely punctulate. Elytra black, finely scabrous, sparsely clothed with cinereous pubescence, sutural margin in front of middle thickened for a short distance and somewhat elevated. Body beneath black, sparsely pubescent with white, and rather densely punctulate. Length .30-.40 inch; 7.5-10 mm.

Two specimens are before me, both females, which differ from all the species in our fauna by the broadly excavated vertex and occiput. The elytra at basal third along the suture are elevated into a slight hump, apparently caused by the thickening and elevation of the sutural margin at that place. The pubescence as in *E. pruinosa* is fine and apt to be lost when the species appears black with a very slight lustre.

Two specimens from Arizona, kindly loaned by Mr. Ulke.

C.

E. pedalis, Lec. New Species, p. 157.

Black, sparsely cinereo-pubescent. Head sparsely punctured, median line finely impressed. Thorax longer than wide, sides behind parallel, at apical third moderately arcuate, median line rather deeply impressed, surface moderately shining, coarsely but not densely punctured. Elytra finely punctato-scabrous and sparsely pubescent. Body beneath black, moderately shining, sparsely punctulate and pubescent. Legs rufous, anterior tibiæ, knees and all the tarsi somewhat darker. Length .36 inch; 9 mm.

Three males are before me having a single spur to the front tibia, slightly arcuate and directed inwards.

Lower California.

E. pardalis, Lec. New Species, p. 157.

Head black, shining, with large smooth spaces, between which the surface is finely and sparsely punctulate and sparsely pubescent. Thorax as broad as long, sub-campanulate, punctured similarly with the head.

Elytra black and shining, with large smooth spaces between which the finely punctured portions are covered with cinereous pubescence forming anastomosing lines. Body beneath black, shining, sparsely pubescent and sparsely punctulate. Length .36–.54 inch; 9–14 mm.

Male. Anterior tibiæ unicalcarate, last joint of maxillary palpi elongate oval, truncate at apex.

Closely allied to the next species, and differs in the smoother surface and the form of the last joint of the maxillary palpi. It is probable that the surface character may change in localities and that the pubescence may cover as much of the surface as in the next species. Should this occur the form of the last joint of the maxillary palpi of the male affords the only means of distinguishing the two species.

Occurs in Arizona.

E. maculata, Say. Journ. Acad. III, p. 298; Lec. Proc. Acad. 1853; p. 340; *conspersa*, Lec. ibid.

Black, opaque, cinereo-pubescent. Head densely and finely punctured. Thorax as broad as long, anterior angles broadly rounded, median line finely impressed, surface finely punctulate. Elytra opaque, cinereo-pubescent, with round denuded spots, distinct from each other, and which are opaque and finely scabrous. Body beneath black, moderately densely punctulate and sparsely pubescent. Length .30–.70 inch; 8–18 mm.

Male. Last joint of maxillary palpi as broad as long, rounded and flattened, penultimate joint broadly triangular. Anterior tibiæ unicalcarate.

The females are always larger than the males, and with the denuded spots more numerous and of greater size. The males are sometimes very minutely maculate and superficially resemble *E. sericans.*

Abundant from New Mexico northward to Dakota and thence westward to California and Oregon.

E. vittata, Fab. Syst. Enb. p. 260; Oliv. Ent. III, 46, p. 13, pl. 1, fig. 3; Lec. Proc. Acad. 1853, p. 340; *Chapmani,* Woodh. Med. Repos. III, p. 214.

This species is too well known to need description here. Length .50–.80 inch; 13–20 mm.

Occurs abundantly in early summer on the vines of potato and tomato, in the Middle States.

E. lemniscata, Fab. Syst. El. p. 279; Lec. Proc. Acad. 1853, p. 341.

Closely resembles the preceding species; differs as follows: Elytra with three black vittæ, legs pale rufo-testaceous, body beneath never entirely black. More slender than *E. vittata.* Length .70–.80 inch; 15–20 mm.

Occurs in the Southern States where it replaces the preceding species.

E. nigritarsis, Lec. Pro. Acad. 1853, p. 340.

Head piceous, densely punctulate, sparsely cinereo-pubescent. Thorax as wide as long, rufo-piceous, median line finely impressed, disc densely punctulate, sides slightly divergent behind, in front broadly arcuate to apex. Elytra rufous inclining to pale brownish, finely scabrous, and finely and sparsely cinereo-pubescent. Body beneath black, moderately shining, sparsely pubescent and rather densely punctulate. Legs rufous, tarsi piceous. Length .36–.60 inch ; 9–15 mm.

Collected on the Mexican Boundary Survey, probably Texas or New Mexico.

E. Stuarti, Lec. Trans. Am. Ent. Soc. 1868, p. 54.

Head black, densely punctulate, behind the eyes densely clothed with fulvous pubescence, occiput with black pubescence, median line moderately impressed deeper at vertex. Thorax broader than the head, one-fourth broader than long, sides arcuate and gradually narrowing to apex, surface densely punctulate densely clothed with moderately coarse fulvous hairs, with a large spot on each side more sparsely nigro-pubescent. Elytra broader than the thorax, gradually dilated to apex, punctato-scabrous, with the pubescence arranged as follows: Lateral and apical margins broadly, sutural very narrowly fulvo-pubescent, a broad band in front of middle fulvo-pubescent, the four spaces thus enclosed are less densely pubescent with black. Body beneath black, shining, fulvo-pubescent, with spaces pubescent with black at the middle and sides of the abdominal segments. Legs black, sparsely fulvo-pubescent. Length .30–.56 inch; 7.5–14 mm.

Occurs in eastern New Mexico. The aspect is that of Tetraonyx.

E. Wheeleri, Ulke. Report of an Exploration in Nevada and Arizona. (See note under *C. tenebrosa.*)

Head black, shining, very sparsely punctured and very sparsely cinereo-pubescent. Thorax black, not wider than the head, as wide as long, sides moderately arcuate, anterior angles broadly rounded, median line finely impressed, surface densely punctured and densely clothed with semi-erect fulvous pubescence, with a very narrow cinereous basal line. Elytra black finely punctato-scabrous, sparsely and very finely cinereo-pubescent. Body beneath black, feebly shining, sparsely punctulate and cinereo-pubescent. Legs black, more densely pubescent than the under surface. Length .30–.44 inch ; 7.5–11 mm.

Collected by the Expedition under Lieut. Wheeler in Arizona,

E. cinerea, Forst. Nov. Spec. Ins. Cent. 1771, p. 62 ; Pallas, Icon. p. 98, pl. E, fig. 30 ; Lec. Proc. Acad. 1853, p. 339 ; *clematidis*, Woodh. Med. Repos. III, p. 213 ; *fimbriata*, Thunb. Diss. Nov. Ins. Sp. VI, p. 109 ; *marginata*, Fab. Syst. Ent. 1775, p. 260 ; Oliv. Ent. III, 46, p. 15, pl. 1, fig. 2.

Black, densely punctulate, beneath densely clothed with cinereous pubescence, vesture of upper surface variable. Head densely punctulate, median line feebly impressed, sparsely cinereo-pubescent. Thorax longer than wide, sub-campanulate, densely punctulate, frequently entirely cinereo-pubescent, usually with a large triangular discal space black, divided by a cinereous line along the middle. Elytra very finely punctato-scabrous, either cinereo-pubescent over the entire surface or merely very narrowly margined with cinereous at sides, suture and apex. Legs black, cinereo-pubescent, tarsi black. Length .40–.60 inch; 10–15 mm.

The form clothed over the entire surface with cinereous does not appear to be separable from that with the greater portion of the elytral surface clothed with black, excepting in this one character alone.

Occurs in the Middle States.

E. funebris, nov. sp.

Black, sub-opaque, moderately clothed with rather coarse black pubescence. Head finely and densely punctulate, median line finely impressed, surface sparsely pubescent. Thorax narrower than the head, slightly longer than wide, sides at basal two-thirds parallel, at apex arcuate; surface densely punctulate and sparsely pubescent. Elytra gradually divergent to apex, opaque, finely punctato-scabrous, and sparsely pubescent. Body beneath and legs black, moderately shining, punctulate and sparsely pubescent. Spurs of hind tibiæ similar to each other, stout, cylindrical, obliquely truncate and concave at tip. Length .76 inch; 19 mm.

Resembles *E. fissilabris* but differs by the form of the hind tibial spurs.

Three specimens from Texas.

E. fissilabris, Lec. Agassiz, Lake Superior, p. 232; Proc. Acad. 1853, p. 339.

Closely resembling the preceding species in sculpture and color, and differs as follows: Thorax shorter, sides less parallel, spurs of hind tibiæ slender acute and of equal length, labrum more deeply emarginate. Length .68 inch; 17 mm.

Occurs in the Lake Superior and Hudson's Bay Regions.

E. corvina, Lec. Journ. Acad. IV, 1858, p. 21.

Black, densely punctulate, feebly shining, sparsely pubescent with short black hairs, aspect velvety. Head densely punctulate. Thorax slightly wider than long, densely punctulate, sparsely pubescent, sides parallel behind, at apical fourth arcuate. Elytra robust, slightly broader to apex, surface minutely punctured, very sparsely and finely pubescent. Body beneath more shining than above, moderately punctulate and sparsely pubescent. Length .80–1.10 inch; 20–28 mm.

The largest species of the genus in our fauna. The spurs of the hind tibiæ are acute at tip, slender, the outer somewhat stouter than the inner.

Occurs from Colorado to Arizona.

E. pensylvanica, De Geer, Mem. V, 1775, p. 15, pl. 13, fig. 1; Lec. Proc. Acad. 1853, p. 339; *atrata*, Fab. Syst. Ent. p. 260; Oliv. Ent. III, 46, p. 17, pl. 2, fig. 19; *coracina*, Illig. Mag. III, p. 171; *nigra*, Woodh. Med. Repos. III, p. 213; *morio*, Lec. Proc. Acad. 1853, p. 447.

This species is so common and so well known that any description is unnecessary. By its surface sculpture and pubescence it resembles *E. funebris* and *E. fissilabris*, but differs from all the black species in having the outer spur of the hind tibiæ stouter and broader than the inner. *E. morio* is slightly more robust but does not otherwise differ. Length .28–.50 inch ; 7–13 mm.

Occurs from the Middle States to Texas.

E. maura, Lec. Ann. Lyc. V, p. 162 ; Proc. Acad. 1853, p. 339.

Black, shining, very sparsely pubescent with black hairs. Head shining sparsely punctulate. Thorax longer than wide, very sparsely punctate, sides at apical third slightly broader. Elytra gradually divergent, subopaque, finely scabrous, very sparsely pubescent. Body beneath black, more shining than the upper surface, sparsely punctulate and pubescent. Spurs of hind tibiæ slender and acute. Length .32–.40 inch ; 8–10 mm.

Male. Middle and hind femora with lower face broad, slightly concave, smooth, and with the margins fimbriate.

Occurs at San Francisco and San Diego, California.

Epicauta sanguinicollis, Lec. Proc. Acad. 1853, p. 344, is unknown to me in nature, having been originally described from a drawing. I cannot assign it a place in the foregoing revision.

In the preceding descriptions but little mention has been made of the sexual characters of each species. In this genus, great uniformity prevails, and in fact the sexes vary but little in the structure of their terminal segments and are, as follows :

Male. Fifth ventral segment truncate, rarely feebly emarginate, sixth oval slightly emarginate at tip.

Female. Fifth ventral always truncate, sixth oval rounded at tip.

CANTHARIS, Linn.

Lytta auct.

The species of Cantharis known to exist within our faunal limits have become moderately numerous and since the publication of the synopsis of the family MELOIDÆ (Proc. Acad., 1853, pp. 328 et seq.) no attempt has been made to bring them before our students in the sense in which the term Lytta has since been restricted (Class. Col. N. Am., p. 273).

In order that the object of the present essay may be the better attained, the species may be divided into three primary groups.

GROUP I. Antennæ of male with intermediate joints (4–5–6–7) either deformed or much thicker than those which precede or follow. Antennæ more or less moniliform in both sexes, gradually stouter to tip in the female and rarely longer than the head and thorax, never equal to half the length of body. Type, *C. vulnerata*, Lec.

GROUP II. Antennæ not dissimilar in structure in the sexes, either moniliform or slender, always gradually stouter toward the tip, in several species longer than half the length of body. Types, *C. cardinalis*, Chev. (moniliform antennæ), *C. stygica*, Lec. (slender antennæ.)

GROUP III. Antennæ with compressed joints: joints 5–10 usually broader than long, thorax very convex, somewhat spherical in form. Both hind tibial spurs slender and acute. Type, *C. compressicornis*, Horn.

GROUP I.

This group contains nearly all the large and imposing species of the genus, which may be arranged as follows:

- Antennæ ♂ with joints 4–5–6 having a prolongation from their upper side.
  - Middle tibiæ ♂ flattened and near the tip somewhat contorted.................................... *eucera.*
- Antennæ ♂ with joints 4 to 7 thicker than the others.
  - Pygidium ♂ prolonged and dilated at tip...... ..... *quadrimaculata.*
  - Pygidium ♂ not dilated at tip.
    - Pygidium ♂ elongate oval more or less acute at tip.
      - Head and thorax black, thorax not pentagonal... *melaena.*
      - Head and thorax red, thorax pentagonal strongly angulate at the sides.
        - Legs entirely red, elytra strongly reticulate.... *magister.*
        - Legs entirely black.
          - Elytra obsoletely reticulate................ *vulnerata.*
          - Elytra strongly reticulate.................. *var. Cooperi.*
    - Pygidium ♂ broad, truncate.
      - Hind trochanter ♂ with acute spine.
        - Fifth abdominal segment ♂ broadly emarginate, lateral lobes prominent.............. *Nuttali.*
        - Fifth abdominal segment ♂ deeply and acutely notched lateral lobes broadly rounded........ *cyanipennis.*
      - Hind trochanter ♂ mutic.
        - Body above not pubescent; tibiæ nearly glabrous.
          - Joints 4–7 ♂ antennæ with short hairs; surface metallic............................ *viridana.*
          - Antennæ not hairy; surface of body black.
            - Thorax pentagonal, sides angulate........ *lugubris.*
            - Thorax longer than wide, sides moderately rounded.............................. *Childii.*
            - Thorax broader than long, sides strongly arcuate.............................. *tenebrosa.*
        - Body above pubescent; tibiæ rather densely pubescent.
          - Body above black; thorax coarsely punctured. *puberula.*
          - Body above in great part yellow; thorax nearly smooth, base at middle emarginate.. *biguttata.*

C. eucera, Chev. Col. Mex. Centur. I, No. 56, 1834.

Head black, impunctured, occiput rufous with narrow median black line. Antennæ black, joints 4–5–6 with a prolongation from their upper distal angle ♂. Thorax black with very few fine punctures, pentagonal, lateral angles not prominent. Elytra black, elongate, parallel, feebly shining, surface finely scabrous. Body beneath and legs black, moderately shining. Length 1-1.15 inch; 25-29 mm.

Male. Antennæ as above. Middle tibiæ flattened and slightly contorted. Fifth ventral segment truncate, sixth moderately prominent and feebly emarginate at tip. Last dorsal segment moderately prominent and broadly rounded at tip.

Female. Sixth ventral segment oval at tip. Antennæ not seen.

The inner spur of the hind tibæ is moderately stout but acute at tip, the outer spur much stouter, very obliquely truncate and laminiform at tip.

Specimens of this species said to have been collected in Texas near the Mexican border are before me.

C. quadrimaculata, Chev. Col. Mex. Centur. I, No. 79, 1834:

Head black, coarsely punctured, moderately shining, vertex with rufous spot. Thorax sub-quadrate, sides in front broadly rounded, disc very feebly convex, surface sparsely punctured, shining, color yellow with four small black spots, the inner two larger. Elytra yellow with an irregular triangular spot at basal third and a larger spot at apical third on each elytron, black; surface scabrous. Body beneath black, with cinereous hairs. Length .60-.80 inch; 15-20 mm.

Male. Antennæ with joints 4-7 stouter. Fifth ventral segment slightly emarginate, sixth moderately prominent deeply emarginate with the lateral processes prominent. Last dorsal segment prolonged at apex and with the tips dilated.

Female. Antennæ not seen. Sixth ventral and last dorsal segments oval at tip.

The spurs of the hind tibiæ are as in the preceding, but the outer is less obliquely truncate and more dilated at apex. The base of thorax at middle is slightly emarginate as in *biguttata* but in a less marked degree.

Occurs with the preceding species.

C. melaena, Lec. Proc. Acad. 1858, p. 76.

Black, moderately shining. Head very sparsely punctate. Thorax sub-quadrate, sides in front broadly arcuate, surface very sparsely punctate. Elytra finely scabrous. Body beneath black, moderately shining, pectus sparsely pubescent. Length .60-.80 inch; 15-20 mm.

Male. Antennæ with joints 4-7 stouter. Fifth ventral segment truncate at middle, sixth deeply emarginate and longitudinally broadly impressed, lateral processes obtuse, moderately prominent. Last dorsal segment acutely oval at tip. Middle tibiæ flat and strongly compressed near the tip.

Female. Sixth ventral segment sub-truncate at apex. Last dorsal broadly oval. Antennæ moniliform gradually thicker to tip. The hinder tibial spurs are similar to those of *C. eucera.*

Occurs near the boundary of Arizona and Sonora.

O. magister. Horn. Trans. Am. Ent. Soc. 1870, p. 90.

Head and thorax orange yellow, shining, very sparsely punctulate. Antennæ brown, basal joint yellow. Thorax sub-pentagonal, sides moderately prominent, disc flattened. Elytra piceous, surface with very coarse reticulations. Body beneath piceous, middle of pectus frequently yellow. Legs and coxæ, orange yellow, glabrous, tarsi brownish. Length .90–1.40 inch; 23–35 mm.

Male. Antennæ as in *melaena.* Fifth ventral truncate, sixth deeply emarginate, lateral processes moderately prominent. Last dorsal segment oval at tip. Middle tibiæ feebly arcuate not flattened.

Female. Antennæ as is *melaena.* Fifth ventral sub-truncate, sixth moderately prominent and sub-truncate at tip.

Hind tibial spurs similar to each other, slender. The largest species of the genus in our fauna. Occurs from Owen's Valley, California, to the Gila River, Arizona.

O. vulnerata, Lec. Ann. Lyc. V, p. 159; Proc. Acad. 1853, p. 331; *var. Cooperi,* Lec. Proc. Acad. 1854, p. 18; Pacif. R. R. Rep. 1857, p. 51, pl. 2, fig. 6.

Head orange yellow, between the eyes piceous, surface nearly impunctured. Thorax pentagonal, lateral angles prominent, disc flattened, smooth, color orange yellow, frequently with broad median piceous stripe. Elytra black sculpture variable. Body beneath and legs black, moderately shining. Length .40–1.10 inch; 10–28 mm.

Var. vulnerata, Lec. Elytra scabrous varying to finely reticulate.

Var. Cooperi, Lec. Elytra coarsely reticulate varying to finely reticulate.

Male, as in *melaena.* Fifth ventral sub-emarginate, sixth deeply emarginate with lateral processes moderately protuberant. Last dorsal segment acutely oval at tip.

Female. Fifth ventral sub-emarginate, sixth oval and sub-truncate at tip. Last dorsal oval at tip.

Outer spur of hind tibiæ stouter than the inner and slightly dilated at tip.

Occurs from Fort Tejon southward to San Diego, thence north to Owen's Valley, California, and thence by the desert regions of Nevada to Southern Oregon. Very abundant.

O. Nuttali, Say, Journ. Acad. III, p. 300; Am. Ent. pl. 3; Proc. Acad. 1853, p. 334; *fulgifer,* Lec. Jour. Ac. N. S. I, p. 90; Proc. Ac. loc. cit.

Head brilliantly æneous, sparsely punctate. Thorax sub-pentagonal surface of disc irregular, shining, sparsely punctate, and brilliantly æneous, sometimes with bluish or cupreous tinge. Elytra with brilliant cupreo-metallic lustre, surface finely reticulato-scabrous. Body beneath and legs metallic green. Length .64–1.10 inch; 16–28 mm.

Male. Antennæ as in *melæna.* Fifth ventral broadly emarginate, emargination at bottom bisinuate, lateral lobes obtuse, moderately prominent, sixth ventral produced, deeply cleft and pilose at apex. Last dorsal segment tubuliform and truncate. Hind trochanter with acute spine at middle.

Female. Fifth ventral sub-truncate, sixth with rounded notch. Hind trochanter sub-angulate. Antennæ as in *melæna.*

Spurs of hind tibiæ dissimilar, inner slender acute, outer broader obliquely truncate and laminiform at tip.

Occurs abundantly in Western Kansas and in Colorado.

C. cyanipennis, Lec. Ann. Lyc. V, p. 160; Proc. Acad. 1853, p. 333; *salicis,* Lec. loc. cit.

Head metallic green, shining, sparsely punctured. Thorax sub-pentagonal, sides obtusely prominent, disc uneven, sparsely punctured, color metallic green. Elytra parallel, bluish or violet, finely scabrous. Body beneath with bluish or greenish metallic lustre. Length .50–.70 inch; 13–18 mm.

Male. Antennæ with intermediate joints moderately thickened. Fifth ventral segment not deeply emarginate at middle, on each side broadly rounded, sixth ventral elongate, deeply cleft. Last dorsal segment tubuliform truncate at apex. Hind trochanters with short spine at middle.

Female. Antennæ gradually thickened to tip. Fifth ventral truncate, with semi-circular emargination. Hind trochanter neither armed with a spine nor sub-angulate.

Spurs of hind tibiæ dissimilar, inner slender acute, outer somewhat stouter, very obliquely truncate and laminate at tip.

The variety *salicis* cannot be separated specifically, it differs by being entirely blue or violet. A variety occurs in Oregon entirely green.

Its distribution extends from Utah to Oregon.

C. viridana, Lec. New Species, p. 162.

Head metallic green, shining, sparsely punctured. Thorax scarcely sub-pentagonal, surface uneven, color greenish metallic, shining with few punctures. Elytra parallel, surface finely scabrous, varying in color from green to violet. Body beneath bluish or violet with greenish reflection. Length .60–.70 inch; 15–18 mm.

Male. Joints 4–8 thicker, anterior face pilose with short hairs. Fifth ventral segment broadly emarginate at middle, six prolonged and deeply cleft. Last dorsal truncate. Hind trochanters mutic.

Female. Antennæ as in *cyanipennis.* Fifth ventral segment truncate, sixth semi-circularly emarginate.

Spurs of hind tibiæ as in *cyanipennis.*

Resembles the preceding species but may be known by the male having the hind trochanters simple, and intermediate joints of antennæ pilose. Its distribution from the Platte Valley northward to Fort Edmonton.

C. lugubris,* Ulke. Explorations in Nevada and Arizona Expedition of 1871, Lieut. G. M. Wheeler, commanding.

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*Through the kindness of Mr. H. Ulke, of Washington, I have been permitted to study this species and also *Epicauta Wheeleri,* which are described by him in the forthcoming report of Lieut. Wheeler. As no copy of the work has yet been received I am unable to quote the pages on which they are described.

Black, sub-opaque. Head between the eyes rugous, occiput with coarse punctures. Thorax as wide as the head, sub-pentagonal, sides moderately prominent, disc convex, surface transversely wrinkled and coarsely punctured. Elytra broader at base than head or thorax, parallel surface finely scabrous. Body beneath and legs black, feebly shining. Length .70 inch ; 18 mm.

Male. Antennæ with joints 5–6–7 decidedly thickened. Fifth abdominal segment truncate, sixth broadly emarginate lateral processes mammiliform moderately prominent. Last dorsal segment rotundato-truncate.

Female. Antennæ as in *cyanipennis.* Fifth ventral truncate, sixth oval slightly emarginate at tip.

Spurs of hind tibiæ as in *cyanipennis.*

In color resembles *Childii,* but allied by form of thorax to the preceding species. Its sexual characters resemble those of the *melæna* but the two species differ in the form of the last dorsal segment of the male as well as in the form of the thorax.

The species occurs in California.

C. Childii, Lec. Pacif. R. R. Rep. p. 52.

Black, feebly shining. Head sparsely punctured. Thorax sub-quadrate, somewhat longer than wide, slightly narrowed at base, sides in front arcuate, surface sparsely punctured. Elytra parallel, very finely scabrous. Body beneath and legs black, moderately shining. Length .60–.70 inch ; 15–18 mm.

Male. Antennæ as in *cyanipennis.* Fifth ventral segment broadly notched at middle, sixth prolonged and deeply cleft, last dorsal truncate.

Female. Antennæ as in *cyanipennis.* Fifth ventral truncate, sixth acutely notched.

Inner spurs of hind tibiæ slender, acute, outer cylindrical obliquely truncate and concave at apex.

Occurs in the Sacramento Valley, California.

C. tenebrosa, Lec. Ann. Lyc. V, p. 160 ; Proc. Acad. 1853, p. 333.

Black, sub-opaque, form moderately robust. Head opaque, finely rugulose, coarsely but sparsely punctured. Thorax opaque sparsely punctured, more densely near the sides, broader than long, sides strongly arcuate in front, slightly narrowed to base. Elytra finely scabrous, less opaque than the thorax. Body beneath and legs black, moderately shining. Length .70–.80 inch ; 19–20 mm.

Male. Unknown.

Female. Fifth ventral segment broadly rounded, sixth oval very slightly emarginate at tip.

Spurs of hind tibiæ both acute, the outer broader.

Not having seen the male either of this species or the next it is impossible to say with certainty that they should be referred to the present group. Their affinities, however, appear to be here rather than in the following group.

Occurs in the region of San Diego, California.

O. puberula, Lec. New Species, p. 162.

Black, very feebly shining, surface moderately clothed with short erect cinereous pubescence. Head coarsely punctured. Thorax as long as wide, sides anteriorly arcuate, behind nearly parallel, base feebly emarginate at middle, disc moderately convex, coarsely punctured. Elytra slightly broader behind, surface coarsely scabrous. Body beneath black, more shining than above. Legs, especially the tibiæ cinereo-pubescent. Length .50 inch ; 13 mm.

Male. Unknown.

Female. Antennæ gradually thicker to tip. Fifth ventral truncate, sixth scarcely prominent, broadly oval at tip.

Inner spur of hind tibiæ slender, acute, outer cylindrical compressed, obliquely truncate at tip.

One female from Arizona readily known by the above characters from any species in our fauna in either group.

O. biguttata, Lec. Proc. Acad. 1853, p. 332.

Body sparsely clothed with yellowish pubescence. Head black, shining, sparsely punctured. Thorax sub-quadrate, anterior angles broadly rounded, disc moderately convex, smooth, scarcely punctate ; color pale yellow with four black spots in transverse arcuate line, the middle two larger, oval, the outer minute. Elytra parallel, scabro-punctate, color pale yellow with one oval spot on each at apical three-fourths. Body beneath black, moderately shining, abdomen at tip yellow. Femora yellow, tips piceous, tibiæ and ~~tarsi~~ piceous, the former pubescent. Length .30–.60 inch ; 7.5–15 mm. tarsi

Male. Antennæ with joints 4–5–3 stouter. Fifth abdominal segment broadly emarginate, sixth very deeply and narrowly emarginate, lateral processes acute and prominent. Last dorsal segment truncate.

Female. Antennæ very feebly dilated at tip. Fifth segment truncate, sixth broadly oval and very feebly emarginate at tip.

Spurs of hind tibiæ as in the preceding species.

From the form above described this species varies to one totally yellow above and beneath, on which only faint traces of the elytral spot and the two middle thoracic spots may be seen. In those specimens in which the head is black, the legs are more or less black, when the head is yellow the knees only are black.

This species occurs abundantly in Arizona and New Mexico.

GROUP II.

In this group the antennæ scarcely differ in the sexes, being at most merely stouter in the male. The larger species have the antennæ moniliform as in the preceding group, while the smaller forms have the antennæ slender and the joints of greater length but always cylindrical. In these latter the antennæ frequently equal or slightly exceed in length half the entire length of the insect. The species may be divided in the following manner.

Anterior tibiæ ♂ with a single spur.................... *moerens.*
Anterior tibiæ ♂ with two spurs.
  Outer spur of hind tibiæ, stout, cylindrical, broader at tip and concave.......................... ... 1
  Outer spur more slender, very obliquely truncate and laminiform at tip.............................. 2
1. Elytra black.
    Thorax, head and legs black.
      Thorax coarsely punctured, sub-pentagonal; Elytra coarsely reticulate................. .... *reticulata.*
      Thorax nearly smooth, sides rounded; elytra finely reticulate............................. *cribrata.*
    Thorax, head and femora red; thorax scarcely punctured.................................. *deserticola.*
  Elytra luteous or fulvous.
    Head, thorax and elytra similar in color.......... *dichroa.*
    Head and thorax black, the latter punctured...... *cardinalis.*
2. Slender species, thorax always longer than wide and narrower than the head.
    Color above, rufo-testaceous...................... *nitidicollis.*
    Color entirely black.............................. *lugens.*
    Color brilliant aeneous, elytra with cupreous tinge. *Rathvoni.*
  Stouter species, thorax as wide or wider than long, and as wide as the head.
  Body above unicolored.
    Color black, varying to brilliant aeneous......... *stygica.*
  Body above bicolored.
    Thorax and elytra similar in color; hind angles of head red....................................... *auriculata.*
    Thorax and elytra dissimilar in color.
      Head and elytra brilliant aeneous, thorax yellowish red with median round metallic green spot... *refulgens.*
      Head and thorax red; elytra with faint greenish bronze surface............................... *æneipennis.*

C. moerens, Lec. Ann. Lyc. V, p. 216; Proc. Acad. 1853, p. 332.

Black, feebly shining, surface with faint bluish tinge. Head coarsely and sparsely punctured. Thorax as broad as long, sides in front arcuate, behind slightly convergent, disc feebly convex sparsely punctulate. Elytra parallel, finely scabrous. Body beneath and legs similar in color to the upper surface. Length .60–.90 inch; 15–23 mm.

Male. Fifth segment broadly emarginate, sixth deeply and acutely notched. Last dorsal segment truncate. Anterior tibiæ with a single terminal spur.

Female. Fifth segment truncate, sixth emarginate, emargination semicircular at bottom. Anterior tibiæ bicalcarate.

Inner spur of hind tibiæ slender acute, outer cylindrical slightly compressed, and obliquely truncate at tip.

Occurs abundantly from Sacramento to Tejon and thence to Keyesville and Owen's Valley, California.

O. reticulata, Say, Journ. Acad. III, 1823, p. 305.

Black, sub-opaque. Head coarsely but not densely punctured. Thorax sub-pentagonal, broader than long, disc moderately convex, coarsely punctured toward the sides. Elytra ornamented with raised, coarsely anastomising lines. Body beneath black moderately shining. Length .80-1.00 inch ; 20-25 mm.

Male. Fifth ventral broadly emarginate, sixth acutely notched.

Female. Fifth ventral truncate, sixth trapezoidal truncate at tip.

Hind tibial spurs as in the preceding species.

Occurs in eastern New Mexico.

O. cribrata, Lec. Proc. Acad. 1853, p. 447.

Black, moderately shining. Head very sparsely punctulate, with large yellow frontal spot. Thorax as broad as long, slightly narrower toward base, sides strongly arcuate in front, disc feebly convex, smooth, very sparsely punctulate ; color black, sides bordered with red. Elytra sub-opaque with fine reticulations. Body beneath black, sub-opaque, rather densely punctulate. Length .70-.80 inch ; 17-20 mm.

Male. Fifth ventral broadly emarginate, sixth semi-circularly notched.

Female. Unknown.

Hind tibial spurs as in *moerens.*

Collected in Texas by the Mexican Boundary Commission.

O. deserticola, Horn. Trans. Am. Ent. Soc. 1870, p. 90.

Head red, smooth. Thorax red, as broad as long, sides regularly arcuate, disc feebly convex, with very few punctures and with four minute black spots in a transverse row arcuate to the front. Elytra black, finely reticulate. Body beneath black, punctulate. Femora red tipped with black, tibiæ and tarsi black. Length .76 inch ; 19 mm.

Male. Unknown.

Female. Fifth ventral broadly rounded, sixth oval at tip and with slight emargination.

Hinder tibial spurs as in *moerens.*

Strongly resembles *dichroa* in form. One specimen from south of Fort Whipple, Arizona.

O. dichroa, Lec. Proc. Acad. 1853, p. 332.

Head luteous, between the eyes and in front black, moderately shining, sparsely punctured. Thorax broader than long, sides moderately arcuate, at base somewhat narrower, disc moderately convex sparsely punctured, color luteous with two median small black spots. Elytra luteous less shining than the head and thorax, finely scabro-punctate. Body beneath and legs black, moderately shining. Length .74-.80 inch ; 18-20 mm.

Male. Fifth ventral broadly emarginate, sixth acutely notched.

Female. Fifth ventral broadly truncate, sixth slightly emarginate at tip. Hind tibial spurs as in *moerens*.

This species occurs in Texas and Mexico and is not rare.

O. cardinalis, Chev. Col. Mex. Centur. I, 1833, No. 13; Lec. Proc. Acad. 1853, p. 447; *fulvipennis*, Lec. loc. cit. p. 331.

Head black, punctate, shining. Thorax broader than long, sides moderately arcuate and obliquely narrowing to the front, disc feebly convex, densely punctate, sparsely pubescent, color black, moderately shining. Elytra opaque, orange red, or fulvous, finely scabro-punctate.

Body beneath and legs black, moderately shining. Length .60–1.00 inch; 15–25 mm.

Male. Fifth ventral broadly emarginate, sixth elevated along its middle and acutely notched at tip.

Female. Fifth ventral truncate, sixth oval at tip.

Hind tibial spurs as in *mœrens*.

Occurs in Colorado, Texas and Mexico.

O. nitidicollis, Lec. Ann. Lyc V, p. 160; Proc. Acad. 1853, p. 332.

Head reddish yellow, shining, with few distant punctures. Thorax longer than wide, sides moderately arcuate, gradually narrowed to apex and base, disc moderately convex, smooth shining, color similar to the head. Elytra fulvous, sub-opaque, scabrous. Body beneath and legs black, moderately shining. Length .50–.70 inch; 13–18 mm.

Male. Fifth ventral very slightly emarginate, sixth with slight crescentic notch, lateral lobes feebly prominent.

Female. Unknown.

Inner spur of hind tibiæ slender acute, outer cylindric compressed, longer than the inner and concave at apex.

By their elongate form this and the two following species resemble *Epicauta*.

Occurs at San Diego, California.

O. lugens, Lec. Ann. Lyc. V, p. 161; Proc. Acad. 1853, p. 335.

Black, moderately shining. Head sparsely coarsely punctate. Thorax black, longer than wide, sides in front moderately arcuate, behind nearly parallel, disc moderately convex with coarse punctures sparsely placed. Elytra elongate black, less shining than the head and thorax, surface coarsely scabrous. Body beneath and legs black, moderately shining.

Length .40–.54 inch; 10–14 mm.

Male. Fifth ventral broadly truncate, sixth slightly emarginate at tip.

Female. Fifth ventral truncate, sixth oval at tip. Spurs of hind tibiæ slender, outer scarcely thicker.

Occurs at San Diego, California.

O. Rathvoni, Lec. Proc. Acad. 1856, p. 335.

Head brilliant metallic green, sparsely punctured. Thorax longer than wide, sides in front arcuate, behind slightly converging to base, disc convex, very sparsely punctate, color as the head. Elytra elongate parallel, surface scabrous, with purplish tinge with greenish reflection. Body beneath and legs metallic green, shining. Length .40 inch ; 10 mm.

Male. Fifth ventral broadly emarginate, sixth longitudinally impressed acutely emarginate at tip.

Female. Unknown.

Hind tibial spurs as in the preceding species.

Occurs from Sacramento to Millerton, California.

O. stygica, Lec. Ann. Lyc. V, p. 161 ; Proc. Acad. 1853, p. 335 ; *smaragdula,* Lec. Ann. Lyc. V, p. 160 ; Proc. Acad. 1853, p. 334 ; loc. cit. 1859, p. 78 ; *dolosa,* Lec. Proc. Acad. 1861, p. 354.

Head with few coarse punctures on the side of the occiput. Thorax slightly broader than long, sides in front moderately arcuate, behind slightly narrowed to base, disc feebly convex sparsely punctate. Elytra nearly twice as wide as thorax, scabrous. Color of body above and beneath variable, from black with slight bronze tinge (*stygica*) bluish or dark violet (*dolosa*) to green, more or less brilliant (*smaragdula*). Length .36–.56 inch ; 9–14 mm.

Male. Fifth segment broadly emarginate, with trapezoidal acutely notched.

Female. Fifth segment truncate, sixth crescentically emarginate.

Spurs of hind tibiæ dissimilar, inner slender acute, outer somewhat stouter obliquely truncate.

This species is very variable in the coloration of the surface as will be seen by the above description. The Oregon specimens are totally black and somewhat more roughly sculptured, those from Mendocino, Cal., to Sacramento are bluish and smoother, those from the lower end of the Tulare Valley and thence to the borders of the Colorado Desert are the more brilliant.

Distributed from Oregon to the borders of the Colorado Desert.

O. auriculata, Horn. Trans. Am. Ent. Soc. 1870, p. 91.

Head black, moderately shining, sparsely punctate, vertical spot and and hind angles broadly red, occiput truncate. Thorax slightly broader than long, sides in front broadly rounded behind parallel, disc feebly convex and with coarse punctures sparsely placed ; color black feebly shining. Elytra with bluish green lustre coarsely scabrous. Body beneath and legs black, moderately shining. Length .36–.50 ; 9–13 mm.

Male. Fifth ventral segment broadly and feebly emarginate, sixth trapezoidal, longitudinally concave, emarginate at apex with the lateral processes moderately prominent.

Female. Fifth ventral truncate, sixth broadly oval at tip. Spurs of hind tibiæ as in the preceding species.

Occurs in the high Sierras near Keyesville, California.

O. æneipennis, Lec. Ann. Lyc. V, p. 160 ; Proc. Acad. 1853, p. 338.

Head in front of eyes black, occiput red, coarsely but sparsely punctured. Thorax one-fourth broader than long, red, sides gradually narrowed to base, in front broadly rounded and suddenly narrowing to apex, disc feebly convex with few scattered punctures. Elytra rather coarsely scabrous with greenish bronze tinge. Body beneath and legs with faint bronze lustre. Length .30–.40 inch; 8–10 mm.

Male. Fifth ventral truncate, sixth feebly emarginate at tip.

Female. Fifth ventral truncate, sixth oval at tip.

Spurs of hind tibiæ as in the preceding species.

Occurs near the borders of the Colorado Desert at Santa Isabel and near Cariso Creek.

C. refulgens, Horn, Trans. Am. Ent. Soc. 1870, p. 91.

Head brilliant metallic green, sparsely but coarsely punctured. Thorax broader than long, sides moderately arcuate and evenly rounded at apical and basal angles, disc moderately convex, with median round aeneous spot, surface smooth shining with few punctures, color pale reddish yellow. Elytra brilliant metallic green, finely scabrous. Body beneath brilliant green, tibiæ cupreous. Length .32–.40 inch; 8–10 mm.

Male. Fifth ventral truncate, sixth slightly concave and emarginate at tip.

Female. Fifth ventral truncate, sixth oval at tip.

Spurs as in the preceding species.

Occurs near Millerton, California.

GROUP III.

This group contains at present three species of moderate size in which the antennæ of both sexes are very strongly compressed, especially in the male, and the joints usually broader than long of nearly quadrate form and scarcely one-third thicker than the width. The antennæ are also short, scarcely longer than the head and thorax. The thorax is more nearly of spherical form than in any other vesicants. Both hind tibial spurs are slender and acute. They may be thus distinguished:

Anterior tibiæ ♂ with two spurs.
  Antennæ ♂ moderately compressed.
    Scutellum deeply sulcate to apex; apex truncate... *sphæricollis.*
  Antennæ ♂ very strongly compressed.
    Scutellum feebly sulcate; apex truncate........... *compressicornis.*
Anterior tibiæ ♂ without terminal spurs.
  Anterior femur ♂ with spine near the base.......... *convexa.*

C. sphæricollis, Say. Journ. Acad. III, 1828, p. 299; Am. Ent. pl. 3: *chalybea*, Lec. Ann. Lyc. V, p. 160; Proc. Acad. 1853, p. 335.

Slender, shining, surface with strong æneous or bronze lustre. Head sparsely punctate. Thorax nearly spherical, narrower than the head, and very sparsely punctate. Scutellum truncate at tip deeply channeled along its entire length. Elytra elongate, parallel, surface finely scabropunctate. Body beneath and legs black with aeneous tinge. Length .32–.50 inch; 8–13 mm.

Male. Fifth ventral broadly emarginate, sixth concave deeply emarginate, the emargination at bottom rounded.

Female. Fifth ventral truncate, sixth broadly rounded at tip.

Hind tibial spurs slender acute, the inner longer.

Occurs abundantly on the plains east of the Rocky Mountains from Nebraska to New Mexico.

C. compressicornis, Horn, Trans. Am. Ent. 1870, p. 91.

Color blue, sometimes inclining to violet, surface moderately shining. Head shining, very sparsely punctate. Thorax nearly spherical, narrower than the head, sides moderately arcuate, sparsely punctate. Scutellum feebly channeled sub-truncate at tip. Elytra twice as wide at base as thorax, gradually wider toward apex, surface punctate scabrous, less shining than the head and thorax. Body beneath darker than above, legs nearly black. Length .30–.50 inch; 8–12 mm.

Male. Antennæ much flattened, joints 5–10 twice as wide as long. Fifth ventral feebly emarginate, sixth trapezoidal, concave, acutely emarginate.

Female. Antennæ with joints 5–10 broader than long. Fifth ventral truncate, sixth oval at tip.

Spurs of hind tibiæ as in the preceding species.

Occurs in Owen's Valley, California.

C. convexa, Lec. Proc. Acad. 1853, p. 336.

Head black, moderately shining, sparsely punctate. Thorax black, moderately shining, very sparsely punctate, narrower than the head, sides in front broadly rounded, behind slightly convergent, disc convex. Scutellum rounded at tip, middle not sulcate. Elytra at base twice as broad as thorax, gradually dilated toward apex, surface punctato-scabrous, with faint bluish lustre. Body beneath shining, black, with faint bluish tinge. Legs black. Length .48 inch; 12 mm.

Male. Antennæ moderately compressed, joints 5–10 not wider than long. Anterior tibiæ without terminal spurs. Anterior femur near base with a short spur. Fifth ventral truncate, sixth semi-circularly emarginate.

Female. Unknown.

Hind tibial spurs as in the preceding species.

Occurs in Texas. The curious male characters at once distinguish it.

In the preceding description much detail has been avoided as not pertinent to the object of the essay, and characters common to all the species have for the most part been entirely omitted except in the synoptic tables. The rufous spot of the vertex has scarcely been noticed, as its presence or absence has merely individual value. Only such points have been touched upon as will enable the student to recognize with ease any species in the collections and determine thereby those which are unknown.

POMPHOPOEA. Lec.

This genus differs but slightly from Cantharis (*Lytta*), the only point of difference being in its deeply emarginate labrum. The species have a different aspect although in many points the two genera approach through *C. moerens*. The species have been already tabulated (Leconte, New Species, p. 161), but the curious sexual characters exhibited by the species do not appear to have been sufficiently noticed.

Anterior tibiæ ♂ with one spur only.
  Tibiæ obliquely grooved on its interior face.......... *polita.*
Anterior tibiæ ♂ with two spurs, the anterior frequently short and slender.
  Anterior tibiæ ♂ stouter than the middle tibiæ and at least moderately arcuate.
    Hind tibiæ ♂ dilated toward apex and strongly compressed.. *unguicularis.*
    Hind tibiæ normal, not flattened.................. *Sayi.*
  Anterior tibiæ ♂ not stouter than the middle and not arcuate.
    Hind tibial spurs short and broad.................. *texana.*
    Hind tibial spurs unequal, inner slender, outer broad.. *aenea.*

P. polita, Say, Journ. Acad. 1823, p. 302; Lec. Proc. Acad. 1853, p. 336; *femoralis*, Lec. loc. cit.

Æneous moderately shining. Tibiæ, tarsi and tips of femora bluish, femur red. Elytra more darkly aeneous than the head and thorax, sparsely punctured and minutely alutaceous. Length .70 inch; 18 mm.

Male. Anterior tibiæ with one terminal spur, anterior face shining, broadly grooved especially at apex. First joint of anterior tarsus slightly obliquely dilated. Inner spur of hind tibiæ slender, acute, outer spur twice as broad as the inner, translucent at tip and obtuse. Last abdominal segment deeply triangularly notched and elevated along its middle.

Female. Anterior tibiæ bicalcarate, not obliquely grooved. Last abdominal segment sub-truncate at tip.

In one female before me the tibiæ are entirely pale and this may result from immaturity.

The specimens before me are from Georgia and South Carolina.

P. unguicularis, Lec. New Species, p. 160.

Æneous, surface glaucous. Legs pale yellowish red, knees slightly tipped with brown. Length .70-.80 inch; 18-20 mm.

Male. Anterior tibiæ moderately broad, stouter than the middle tibiæ and more arcuate, inner face broadly grooved from base to apex, at tip bicalcarate. First joint of anterior tarsus compressed. Hind tibiæ moderately broad, rather strongly compressed and acute on the inner edge, inner spur slender, outer broad, but not obtuse at tip. Last abdominal segment very deeply incised and deeply concave, penultimate segment broadly emarginate and in front of margin slightly thickened.

Female. Terminal segment of abdomen feebly emarginate and slightly impressed at tip. Anterior tibiæ straight.

One pair, Illinois.

P. Sayi, Lec. Proc. Acad. 1853, p. 336.

Olivaceo-aeneous, sub-opaque. Legs pale reddish yellow, knees, tips of tibiæ and tarsi bluish black. Length .60–.70 inch; 15–18 mm.

Male. Anterior tibiæ moderately arcuate, broader than the middle tibiæ, at tip bicalcarate. Hind tibiæ normal, inner spur slender, outer rather suddenly dilated and broadly triangular at tip. Last abdominal segment broadly triangularly emarginate, lateral lobes prominent, penultimate segment broadly emarginate and slightly thickened in front of the margin.

Female. Anterior tibiæ not broader than the middle. Terminal abdominal segment slightly notched and feebly longitudinally impressed.

Occurs in Illinois and Texas.

P. texana, Lec. New Species, p. 161.

Olivaceo-aeneous or slightly bronzed. Legs pale reddish yellow, tarsi gradually piceous to tip. Length .50–.60 inch; 13–15 mm.

Male. Anterior tibiæ straight, scarcely broader than the middle, at tip bicalcarate, anterior spur very slender and shorter than the posterior. Middle tibiæ slightly arcuate. Hind tibiæ slightly flattened and with the inner edge acute, spurs short and broad, the inner less broad than the outer. Last abdominal segment broadly triangularly emarginate, at middle feebly carinulate. Penultimate segment broadly emarginate.

Female. Terminal segment with small semi-circular emargination. Hind femora stouter than in the male.

Occurs in Texas.

P. aenea, Say, Journ. Acad. 1823, p. 301; Lec. Proc. Acad. 1853, p. 337; *nigricornis*, Lec. Journ. Acad. 4to, I, p. 90; *filiformis*, Lec. loc. cit. p. 91; Lec. Proc. Acad. loc. cit.; *tarsalis*, Bland, Proc. Ent. Soc. Phil. 1864, p. 71.

Dark aeneous or bronzed, sub-opaque. Legs pale reddish yellow knees, tips of tibiæ and tarsi piceous or black. Length .34–.68 inch; 9–17 mm.

Male. Anterior tibiæ slender, straight, at apex bicalcarate, middle tibiæ slightly arcuate. Hind tibiæ slightly compressed, inner spur slender, acute, outer broader, but acute at tip. Last abdominal segment, triangularly emarginate, penultimate broadly emarginate.

Female. Last abdominal segment sub-truncate at tip.

Occurs in Pennsylvania, Illinois and Texas.

I cannot separate either *filiformis* or *tarsalis*, the former appears to be merely a poorly developed specimen and the latter has the pubescence much better preserved, and the tarsi somewhat darker.

In the preceding notes no mention is made of the pubescence. It is very probable that all the species when recently taken are sparsely clothed with a fine sub-erect greyish pubescence which is easily removed by immersion in alcohol. All the species present the curious character, unknown to me elsewhere among the Meloidæ, of having the inner spur of the middle tibiæ arcuate and pointing backwards.

REVISION OF THE GENERA AND SPECIES OF THE TRIBE HYDROBIINI.

By George H. Horn, M. D.

(*Read before the American Philosophical Society, February* 21, 1873.)

The tribe Hydrobiini comprises all those genera of Hydrophilidae in which the middle and hind tarsi have the first joint very short, and all the joints are of cylindrical form, or at least not compressed and oar-like. The thorax at base is always as wide as the base of the elytra, and the metasternum never prolonged into a spine behind the coxæ. The genera may thus be tabulated :

Head in front of eyes narrow ; labrum visible.......... HYDROBIINI.
Fifth abdominal segment emarginate ; antennæ 7-jointed.. Berosus.
Fifth segment entire.
First two segments concealed by plates............ Chætarthria.
Abdominal segments not concealed.
Abdomens with more than six segments......... Limnocharis.
Abdomen with five segments, tip of sixth frequently visible.
Antennæ 8-jointed... Laccobius.
Antennæ 9-jointed.
Maxillary palpi with fourth longer than third joint.. Hydrobius.
Maxillary palpi with fourth joint shorter.... Philhydrus.
Clypeus broadly dilated at sides ; labrum concealed.... HELOPELTINI
Margins of thorax and elytra broadly expanded ; maxillary palpi very long....................... Helopeltis.

In *Berosus* the sixth abdominal segment is always visible in the emargination of the fifth, it has also seven-jointed antennæ, an elongate scutellum and ciliate tibiæ and tarsi. *Limnocharis* and *Laccobius* have eight-jointed antennæ, the latter has large trochanters to the hind femur while the former has eight very distinct segments to the abdomen. All the other genera have nine-jointed antennæ.

Berosus. Leach.

From all the genera of the group Hydrobiini, Berosus may be known by the seven-jointed antennæ, the elongate scutellum and the hind pair of tibiæ and tarsi pilose. Certain characters common to all the species appear to have been entirely overlooked by previous authors, or at least no mention made of them. The under side of the head behind the mentum is provided with a longitudinal carina, more or less evident according to the species, and as this ridge is more or less developed, so also is the middle of the anterior edge of the prosternum notched for its reception when the head is in repose. The mesosternum is always more or less cristate and the free angle of the crest with an acute prolongation also variable. The fifth segment of the abdomen is always deeply notched, the sides of the notch being straight and slightly reflexed, the bottom either truncate (*pugnax*), broadly lobed (*styliferus*), unidentate (*peregrinus* group), or bidentate (*striatus* group). Beyond the fifth segment the sixth is usually plainly visible, especially in the males. Between the hind coxæ the first segment is distinctly carinate, the carina extending frequently the entire length of the segment. In many species the males have the second, third and fourth segments elevated at middle, sometimes forming merely an elevated line, at others a triangular carina. The species in our fauna may be divided into three sub-genera, the last of which might with propriety be received as distinct.

Epistoma prolonged, eyes large, prominent.
  Elytra at apex, spinous or emarginate................ *Enoplurus.*
  Elytra not spinous, rarely acutely prolonged......... *Berosus.*
Epistoma short, broadly rounded, eyes not prominent.
  Form very convex, strongly compressed at sides..... *Volvulus.*

The species of the sub-genus *Enoplurus* are :
  Elytra unispinous at apex, spine not sutural......... *punctatissimus.*
  Elytra bispinous at apex.
    Fifth abdominal segment bidentate at middle...... *miles.*
    Fifth segment truncate at middle.................. *pugnax.*
  Elytra emarginate at apex.
    Fifth segment bidentate ; male abdomen not carinate
      beneath.................................... *emarginatus.*

B. punctatissimus, Lec. Ann. Lyc. V, p. 211 ; Proc. Acad. 1855, p. 363.

Head black, surface with brilliant cupreous metallic lustre, coarsely and densely punctured, vertex finely carinate. Thorax coarsely punctured, testaceous, a median elongate oval space with cupreous lustre, divided longitudinally and an irregular small patch on each side. Elytra striate, more deeply toward the sides and apex, striæ coarsely punctured, interspaces densely punctulate. Body beneath black, opaque. Legs testaceous, femora black, opaque and pubescent at base. Length .24–.30 inch ; 6–7.5 mm.

Male. Second and third joints of anterior tarsi more dilated, third segment of abdomen with feebly elevated line, fourth with moderate triangular crest, fifth with strong crest, first segment feebly carinate between the coxæ.

The mesosternal crest is not very prominent and has a small tooth at middle. The mesosternum in front of hind coxæ is carinate at middle and on each side dentate. The color of the upper surface is testaceous, the elytra irregularly maculate with fuscous. Elytra at apex unispinous, spine not sutural. California and Arizona.

B. miles, Lec. Proc. Acad. 1855, p. 363.

Head with aeneous tinge, coarsely not densely punctured, vertex finely carinate. Thorax minutely alutaceous, sparsely punctured. Elytra finely striate, striæ externally deeper, punctured, intervals sparsely punctulate, surface very minutely alutaceous; apex bispinous, the outer spine longer. Pectus black, abdomen pale rufo-testaceous or black. Legs entirely testaceous. Length .28 inch; 7 mm.

Male. Tarsi as in *punctatissimus.* Fourth and fifth segments of abdomen also similar. Abdomen black or piceous margined with testaceous.

Female. Abdomen rufo-testaceous.

The form of this species is similar to the preceding, the surface smoother, more shining. Its color is pale testaceous with irregular spots.

Occurs in Texas and Arizona, Lower California.

B. pugnax, Lec. New Species, 1863, p. 24.

Head with aeneous surface, coarsely but not densely punctured. Thorax coarsely punctured, with median divided aeneous vitta. Elytra rather deeply striate, striæ coarsely punctured, intervals punctured, nearly as densely as in *punctatissimus.* Body beneath piceous, legs pale testaceous. Fifth segment of abdomen emarginato-truncate at middle, the side teeth of the emargination short and widely distant. Elytra bispinous at apex, the outer spine long and slender. Length .20 inch; 5 mm.

The two sexes have no special distinction beneath, the abdomen being entirely simple.

Occurs in Illinois and Missouri.

B. emarginatus, n. sp.

Pale yellowish testaceous, moderately shining. Head black with bronzed surface, sparsely punctured. Thorax twice as wide as long, sparsely punctured with median fuscous stripe from apex to base. Elytra yellowish testaceous, maculate as in *striatus,* striate, striæ nearly equal, punctured, intervals sparsely punctured with punctures nearly as coarse as those of the striæ; apex of each elytron emarginate. Body beneath piceous. Legs testaceous. Length .20 inch; 5 mm.

The fifth segment of the abdomen is emarginate as usual and with two teeth at the bottom of the emargination. The male has the anterior tarsi dilated and the abdominal segments not carinate. This species resembles a small *B. miles,* but may be known by the simply emarginate elytra and the abdomen not carinate in the male.

One specimen, Texas.

B. maculosus, Mann. Bull. Mosc. 1853, III, p. 167; *tesselatus,* Motsch. Bull. Mosc. 1859, III, p. 180.

This species from Alaska remains unknown. From the description it closely resembles *punctatissimus,* but is smoother, and less punctured.

The species of the sub-genus BEROSUS are more numerous and may be arranged in the following manner:

Fifth segment of abdomen with broad short lobe at middle of emargination.

Mesosternal crest with a long acute spur............ *styliferus.*

- Fifth segment of abdomen with one tooth at middle.
  - Elytra prolonged at apex especially in ♀.
    - Abdomen at middle cristate ♂.................... *aculeatus.*
    - Abdomen of ♂ not cristate....................... *subsignatus.*
  - Elytra similar in the sexes, not prolonged.
    - Abdomen cristate ♂.
      - Elytra with well-defined black spots............ *pantherinus.*
      - Elytra with spots indistinct..................... *peregrinus.*
      - Elytra entirely testaceous....................... *immaculatus.*
    - Abdomen not cristate ♂.
      - Head testaceous; abdomen testaceous........... *exiguus.*
      - Head bronzed; abdomen piceous................ *exilis.*
- Fifth segment of abdomen bidentate at middle; abdomen never cristate.
  - Thorax twice as wide as long, sides arcuate.
    - Striæ of elytra nearly obliterated on the disc...... *infuscatus.*
    - Striæ strongly impressed and punctured on the disc. *striatus.*
  - Thorax not twice as wide as long, sides nearly straight.
    - Striæ deeply impressed, very coarsely punctured... *rugulosus.*

B. styliferus, n. sp.

Head black with aeneous surface, coarsely punctured, vertex finely sub-carinate. Thorax more than twice as wide as long, sides nearly straight, anterior angles rounded, disc moderately punctured, shining with a median double vitta; color pale testaceous. Elytra shining, very finely striate, striæ finely punctured, punctures of the outer striæ coarser, intervals nearly smooth on the disc; color pale testaceous, obsoletely maculate with fuscous. Body beneath black, legs entirely pale testaceous. Mesosternal crest at apex produced into a long slender style. Abdominal segments not carinate in the male, fifth segment at apex emarginate, middle of emargination with broad short lobe not dentiform. Length .20 inch; 5 mm.

Very closely resembling superficially the California varities of *B. infuscatus* (*var californicus*), but may be at once distinguished by the rounding of the bottom of the emargination of the fifth abdominal segment, and by the long slender style into which the mesosternal plate is produced..

One ♂ specimen, Colorado, kindly loaned by Mr. G. R. Crotch.

B. aculeatus, Lec. Proc. Acad. 1855, p. 363.

Color pale testaceous, head black with bronzed surface, coarsely punctured, vertex sub-carinate. Thorax less wide than twice the length, sides nearly straight, surface coarsely but sparsely punctured but more densely at the sides; color testaceous, immaculate. Elytra deeply striate, striæ coarsely punctured, those at the sides deeper and more coarsely punctured, intervals feebly convex, irregularly biseriately punctulate; apex acute ♂ and more decidedly prolonged ♀; color testaceous with four indistinct fuscous spots on each elytron, one humeral, two at the middle on the second and third intervals and one lateral. Body beneath pale rufo-testaceous. Legs pale testaceous. Length .16 inch ; 4 mm.

Male. Third and fourth segments of abdomen slightly carinate, apex of elytra acute.

Female. Abdominal segments simple, apex of elytra acutely prolonged.

Two specimens from North Carolina.

B. subsignatus, Lec. Proc. Acad. 1855, p. 364.

Head and thorax as in the preceding species, the thorax with two short fuscous patches. Elytra pale testaceous, deeply striate, outer striæ deeper, striæ coarsely punctured, intervals flat, finely alutaceous, irregularly punctured, punctures not deeply impressed. Body beneath and legs, pale rufo-testaceous. Mesosternal crest moderate, mucronate at apex. Abdomen simple in both sexes. Length .16 inch ; 4 mm.

Male. Apex of elytra obtuse.

Female Apex of elytra very acute.

Not rare from Utah to Texas. The elytra are maculate in a manner similar to *B. aculeatus.*

B. pantherinus, Lec. Proc. Acad. 1855, p. 364.

Head as in *aculeatus*, thorax less densely punctured, sides apparently convergent in front, disc bimaculate. Elytra less deeply striate than either of the two preceding species, striæ coarsely punctured, intervals roughly punctured ; color pale yellowish testaceous, sutural interval frequently piceous, on each elytron ten black spots of moderate size, one humeral, another within and slightly below it, four arranged in a sinuous transverse band in front of middle, three arranged transversely behind the four and one sub-apical. Body beneath pale rufous, abdomen usually darker. Legs pale testaceous. Length .16 inch ; 4 mm.

Male. Segments 2–3–4 of abdomen slightly carinate.

Illinois, Missouri, Texas.

B. peregrinus, Hbst. (*Hydrophilus*) Col. VII. p. 314, pl. 114, pg. 12 ; *auritus*, Mels. Proc. Acad. II, p. 100 ; Lec. Proc. Acad. 1855, p. 364.

Resembles the preceding species in form and color, and differs as follows. Head slightly impressed between the eyes, vertex finely subcarinate. Elytra yellowish testaceous, striæ of the disc less distinct than those of the sides, intervals more finely punctured ; spots very indistinctly defined. Body beneath variable in color from pale rufo-testaceous to piceous without reference to sex. Sexual characters as in *pantherinus.* Length .16 inch ; 4 mm.

Occurs from Massachusetts to Missouri, Florida and Arizona.

B. immaculatus, Zimm. Trans. Ent. Soc. 1869, p. 249.

Smaller and more slender than the preceding, and totally yellowish testaceous with but slight traces of spots on the elytra. The elytra are more deeply striate and comparatively more coarsely punctured, the intervals convex and approaching *pantherinus* in rugulosity. Sexual characters as in the preceding species. Length .12–.16 inch ; 3–4 mm.

The three species above form a series that may possibly unite as varities of *peregrinus* when a large series of specimens has been studied.

Occurs in North Carolina, Illinois and Missouri.

B. exilis, Lec. Ann. Lyc. V, p. 211; Proc. Acad. 1855, p. 366.

Head brilliantly cupreous, moderately coarsely and densely punctured. Thorax twice as wide as long, surface coarsely punctured, brilliantly cupreous, lateral and apical margins testaceous. Elytra yellowish testaceous, very indistinctly maculate, surface rather deeply striate, outer striæ deeper, striæ coarsely and serrately punctured, intervals slightly convex, sub-rugulose and with a row of moderate punctures, Mucro of mesosternal crest broad at apex. Body beneath piceous black, legs pale testaceous, femora piceous. Length .10–.12 inch; 2.5–3 mm.

The mesosternal mucro when seen on its tip apparently splits into two parts in the form of a V, the open portion being posteriorly.

Gila River, Arizona.

B. exiguus, Say, (*Hydrophilus*) Journ. Acad. V, p. 189; *pallescens*, Lec. Proc. Acad. 1855, p. 366.

Color above and below yellowish testaceous. Head coarsely but sparsely punctured. Thorax twice as wide as long, surface very minutely alutaceous, coarsely and rather densely punctured. Elytra with moderately deep striæ, those of the outer series deeper; striæ coarsely punctured, intervals slightly convex, punctured. Mesosternal mucro at apex acute.

Pennsylvania to Louisiana.

B. infuscatus, Lec. Proc. Acad. 1855, p. 365; *punctulatus*, Lec. Ann. Lyc. V, p. 211; Proc. Acad. 1855, p. 365; *californicus*, Motsch. Bull. Mosc. 1859, III, p. 179.

Color yellowish testaceous above. Head black with bronze lustre, surface very minutely alutaceous, punctulate more densely in front, vertex sub-carinate. Thorax twice as wide as long, surface finely alutaceous, sparsely and equally punctured, color testaceous at middle with a divided fuscous spot. Elytra striate, striæ of disc replaced by rows of fine punctures, outer striæ moderately impressed, punctured, intervals flat very sparsely punctulate, color testaceous obsoletely piceo-maculate. Body beneath piceous, middle and hind femora at base also piceous. Length .20–.24 inch; 5–6 mm.

Male. Surface shining.

Female. Surface minutely alutaceous between the punctures.

I am entirely unable to separate the Pacific forms from those found on the Atlantic slope.

Occurs in all the Gulf States, Colorado, Arizona, and thence to south-eastern California.

B. striatus, Say, (*Hydrophilus*) Journ. Acad. V, p. 188; *ordinatus*, Lec. Proc. Acad. 1855, p. 365; *fraternus*, Lec. loc. cit. p. 364.

Resembles the preceding closely but differs in having the striæ of the disc of the elytra distinctly impressed. It is always smaller and more robust than *infuscatus*. Length .16–.20 inch; 4–5 mm.

In the males of clearly punctured surface, the third interval of the elytra has coarse punctures interspersed among the usual punctures; in the female this is rarely seen.

Occurs in the Middle and New England States.

B. rugulosus, n. sp.

Form resembling *peregrinus*, color pale piceo-testaceous. Head black with brilliant aeneous surface, densely and coarsely punctured. Thorax coarsely punctured, with median piceous space with aeneous lustre: not twice as wide as long, sides nearly straight slightly convergent. Elytra deeply striate, striæ very coarsely serrately punctured, intervals moderately convex, punctato-rugulose; color pale piceo-testaceous maculate with piceous spots similar to *pantherinus* but less distinct. Body beneath rufo-testaceous, legs paler. Length .20 inch; 5 mm.

Easily known from *striatus* by its more robust form, and more roughly sculptured thorax.

Peninsula of Lower California, W. M. Gabb.

The sub-genus VOLVULUS contains in one fauna but one species.

B. altus, Lec. Proc. Acad. 1855, p. 366.

Oblong oval, narrower behind, sides strongly compressed, transversely very convex, higher than wide; color piceous black with slight bronze lustre. Head coarsely punctured, sparsely on the vertex, more densely on the clypeus. Thorax nearly crescentic in form, the sides and base forming a continuous curve, anterior angles obtusely rounded, apex emarginate, surface sparsely punctured. Elytra striate, striæ of the disc faint and finely punctured, those of the sides deep and coarsely punctured, intervals biseriately punctulate on the disc, uniseriately at the sides. Body beneath black, legs rufous, femora very narrowly pubescent at base. Length .08 inch; 2 mm.

The fifth segment of the abdomen is deeply emarginate as in all the preceding species of Berosus, but whether there is any tooth at the bottom of the emargination, I am at present unable to determine. The sexual characters have also not been seen. Volvulus appears to me worthy of being considered a distinct genus from the form of the front, and the short and robust hind femora.

Occurs in Louisiana.

CHÆTARTHRIA. Steph.

Cyllidium, Erichs.

In this genus the first joint of the antennæ is long. The first two or three segments of the abdomen concealed by plates which meet on the median line. The prosternum in front of the coxæ is always short and the under side of the head in repose rests upon the anterior coxæ. The species are partially contractile in the manner of certain of the forms of Agathidium.

Three species exist in our fauna.

Body above piceous black.
  Sutural stria obliterated at basal third............ *nigrella.*
  Sutural stria very fine at basal third, but visible... *atra.*
Elytra testaceous, head black............................ *pallida.*

These species are all very convex, shining, scarcely punctulate, the first two piceous black, the sides of the thorax piceo-testaceous and partially diaphanous, the sides of elytra are similarly margined, the extent of the pale portion becoming greater toward the apex. The third species is entirely pale piceo-testaceous, the head alone being black and shining.

O. nigrella, Lec. (*Cyllidium*) Proc. Acad. 1861, p. 342.

The sutural stria of the elytra is rather deeper than in the following species, but without any trace at the tarsal third. Length .06 inch; 1.5 mm.

Occurs in California, at San Diego and Visalia.

O. atra, Lec. (*Cyllidium*) New Species, 1863, p. 24.

Length .08 inch; 2 mm.

Occurs in New York.

O. pallida, Lec. (*Cyllidium*) Proc. Acad. 1861, p. 342; *nigriceps,* Lec. loc. cit.

Length .04-.06 inch; 1-1.5 mm.

Occurs in California and also at Lake Superior. I find it impossible to separate the types of the two above noted.

LACCOBIUS. Er.

Two species are described in our fauna.

L. agilis, Rand. Bost. Journ. 2, p. 19; *punctulatus,* Mels. Proc. Acad. 2, p. 100; Lec. Proc. Ac. 1855, p. 363.

Length .08-.12 inch; 2-3 mm.

Extends from the Middle States westward to California and Oregon.

L. ellipticus, Lec. Proc. Acad. 1855, p. 363.

Length .10 inch; 2.5 mm.

These two species resemble each other very closely. The latter is less broad and the punctures of the disc of the elytra less distinctly arranged in rows, being in the large majority of specimens very confused.

Occurs in the southern regions of California and in Arizona and Lower California.

The two genera which follow, *Philhydrus* and *Hydrobius,* differ in the relative length of the joints of the maxillary palpi, the terminal joint being shorter than the preceding in the former and longer in the latter. By an error on the part of the compositor the two genera are transposed on page 47 of the Classification of the Coleoptera of North America, characters the reverse of those above indicated are thus presented to the student. The genus *Sperchopsis* there indicated will be found included in *Hydrobius* as the palpi are absolutely identical.

PHILHYDRUS. Solier.

Our species may be divided into two sections:

Mesosternum with longitudinal crest.............. *Philhydrus.*
Mesosternum simple, rarely with transverse carina. *Helochares.*

The section *Philhydrus* is again divisible in the following manner:

Prosternum elevated in form of crest.............. *Group I.*
Prosternum simple................................ *Group II.*

The first group contains comparatively few species.

Prosternum feebly cristate.
Elytra with rows of large punctures........... *normatus.*
Elytra densely punctulate..................... *carinatus.*
Prosternum strongly cristate, crest more elevated in front.
Elytra distinctly punctulate.
Mesosternal crest at free angle mucronate. { *fucatus.* *nebulosus.*
Elytra nearly smooth.
Mesosternal crest acute but not mucronate. { *cristatus.* *pectoralis.*

P. normatus, Lec. Proc. Acad. 1861, p. 341.

Oblong oval, narrower in front, moderately convex, shining. Head moderately but not densely punctured. Thorax gradually narrowed to the front, sides moderately arcuate, surface more finely punctured than the head, punctures at sides more distinct but not denser. Elytra broadly oval, broadest behind the middle, surface shining and with ten entire striæ of coarse punctures, of which the outer two are closer and slightly sinuous, and a short scutellar stria of smaller punctures, marginal space smooth; interstrial spaces very minutely and sparsely punctulate. Body beneath black, shining, sparsely punctulate and pubescent. Femora piceous, pubescent except at tip, tibiæ and tarsi piceous-rufous. Palpi and antennæ testaceous, the club of the antennæ darker. Mesosternum with a crest not very prominent, prosternum moderately cristate, crest not more prominent in front. Length .20–.22 inch; 5–5.5 mm.

Var. Piceous, disc of thorax somewhat darker. (Type, discolored.)

Var. Ochraceous, with labrum, frontal suture, occiput and large discal space of thorax black. Elytral punctures surrounded by a transverse quadrate piceous space.

The latter variety is the normal coloration of the species, the type being a discolored specimen.

Occurs from San Francisco southward to Cape San Lucas, and thence eastward to Arizona.

P. carinatus, Lec. Proc. Acad. 1855, p. 370.

Oblong oval, slightly narrower in front, convex, black, very shining, thoracic margin piceous, surface equally punctured with moderate punctures not densely placed, elytra with three rows of nearly obsolete coarser punctures, the first near the sutural stria, the second at the middle and the third lateral. Body beneath as in *normatus*. Mesosternal crest acute at tip, under edge sinuate and with the tip pointing downwards. Prosternum feebly cristate. Length .20 inch ; 5 mm.

Occurs from Oregon to San Francisco.

P. fucatus, n. sp.

Oblong oval, slightly narrower in front. Head black, thorax and elytra ochraceous, surface very shining, more finely and less closely punctulate than the preceding, but more distinctly punctured on the thorax than the elytra. Body beneath black, finely punctulate and very sparsely pubescent. Femora, black, opaque, punctured and pubescent except at tip. Tibiæ and tarsi rufous. Palpi and antennæ testaceous, the club of the latter somewhat darker. Mesosternal crest prominent, slightly mucronate at tip. Prosternal crest moderate, more prominent in front. Length .20 inch ; 5 mm.

Broader and less convex than *carinatus* and scarcely narrowed in front. The sculpture is similar in both, but the thorax is rather more distinctly punctured in the present species. From the four species which follow, it differs by its larger size and more prominent mesosternal crest slightly mucronate at tip.

Utah and Arizona.

P. nebulosus, Say. (*Hydrophilus*,) Long's Exped. 2, 277.

Oblong, equally narrowed at each extremity. Head black, clypeus on each side ochraceous. Thorax and elytra pale ochraceous, the former usually paler. Surface finely and sparsely punctulate, head more distinctly punctured than the thorax, and the thorax than the elytra. Body beneath black, sparsely punctulate and pubescent and feebly shining. Femora black, tibiæ and tarsi piceo-testaceous. Palpi and antennæ testaceous the club slightly darker. Mesosternal crest with angle acute but not mucronate, prosternal crest moderate, more strongly elevated in front. Length .16 inch ; 4 mm.

Occurs from Canada to Georgia and Kansas.

Closely resembles *ochraceus*, but may be distinguished by the more prominent mesosternal crest as well as by the presence of the prosternal elevation. The three rows of nearly obsolete larger punctures on the elytra of most of our species, are scarcely visible in the present one.

P. pectoralis, Lec. Proc. Acad. 1855, p. 370 ; *maculifrons*, Motsch. Bull. Mosc. 1859, III, p. 179.

Similar to the preceding, but smaller, more elongate, more shining, punctures of surface scarcely visible. Clypeus testaceous with narrow median fuscous band. Head black. Length .11 inch ; 3 mm.

P. cristatus, Lec. loc. cit.

More elongate than *pectoralis*, and more narrow in front than behind. Sides of thorax feebly arcuate. Elytra more distinctly punctured than *pectoralis* but less so than *nebulosus*. Head black, clypeus black, except a small space in front of the eyes. Disc of thorax clouded with fuscous. Length .13 inch; 3.3 mm.

This and the preceding occur in California.

The species in which the mesosternum is cristate and the prosternum simple, are not so readily distinguished.

Elytra striate, mesosternal crest spiniform............ *bifidus.*
Elytra not striate.
  Mesosternal crest very short........................ *ochraceus.*
  Mesosternal crest produced, with acute free angle.
    Elytral margin slightly but distinctly explanate.
      Color entirely testaceous........................ *reflexipennis.*
    Elytral margin not reflexed; color never entirely testaceous.
      Very convex species, sides of elytra almost vertical, color usually very black, and shining.
        Under edge of mesosternal crest oblique, body above entirely black, shining.............. *consors.*
        Under edge of mesosternal crest horizontal, thickened, body with piceous margin...... *cinctus.*
      Feebly or moderately convex species, sides of elytra gradually descending, color above rarely black, usually pale piceous.
        Mesosternal plate having the anterior edge sinuous in front, the angle very acute and not mucronate.................................. *diffusus.*
        Mucronate.................................. *fuscus.*
        Mesosternal plate with the anterior edge oblique not sinuous, the angle very broad.
          Elongate oval.............................. *perplexus.*
          Broadly oval.............................. *latiusculus.*

P. bifidus, Lec. Proc. Acad. 1855, p. 371.

Elliptical, moderately convex, black, shining, thorax and elytra with piceous margin. Surface moderately densely punctulate, punctures of elytra coarser than those of thorax. Elytra with ten moderately deep striæ, the outer deeper than the inner, striæ four to ten nearly entire, the inner three striæ gradually shorter, sutural stria at one-fourth from apex dividing into two rows of fine punctures. Body beneath black, moderately shining. Mesosternal crest acute, spiniform. Legs piceous black, tarsi paler. Second joint of maxillary palpi scarcely longer than the third. Length .28 inch; 7 mm.

Resembles several of the species of Hydrobius but differs in the short terminal joint of the palpi. The character shown by the inner striæ is not very evident except in immature specimens. In only one of the mature specimens are there punctures, slightly coarser than those of the surface generally, diverging from the tip of the sutural stria, a character of frequent occurrence in *Hydrobius*.

Occurs from Canada to Georgia.

P. ochraceus, Mels. Proc. Acad. II, p. 101; Lec. Proc. Acad. 1855, p. 371; *simplex*, Lec. New Species, p. 24.

Oblong oval, equally narrowed in front and behind, pale piceo-testaceous, vertex and middle of clypeus usually piceous, surface moderately shining, rather coarsely punctured, the punctures of the thorax finer and denser than those of the elytra. Body beneath black, legs piceous tarsi paler. Length .14 inch; 3.5 mm.

Resembles *nebulosus* and *reflexipennis* but may be distinguished from the former by the absence of prosternal carina and from the latter by the very narrow crest of mesosternum which does not form an acute free angle. *P. simplex*, Lec. is a small form differing only in size and in being somewhat smoother.

Occurs from Massachusetts to Florida.

P. reflexipennis, Zimm. Trans. Am. Ent. Soc. 1869, 250.

Pale piceo-testaceous. Resembles the preceding species in all the characters of the upper surface except that the head is never piceous. Body beneath black. Femora at base piceous tibiæ and tarsi pale testaceous. Elytral margin especially at apex sub-explanate. Mesosternal crest acute at tip and mucronate. Length .14-.18 inch; 3.5-4.5 mm.

Specimens are from New Jersey and Delaware.

P. consors, Lec. New Species, p. 24.

Oblong, black, shining, finely and densely punctured, transversely strongly convex, sides nearly vertical. Anterior edge of mesosternal crest oblique. Sutural stria faint scarcely deeper at apex. Body beneath and legs entirely black. Length .28-.32 inch; 7-8 mm.

Louisiana.

P. cinctus, Say (*Hydrophilus*) Long's Exped. 2. 276; Lec. Proc. Acad. 1855, p. 371; *limbalis* Mels. Proc. Acad. 2, p. 101.

Broadly oval, black, shining, entire margin piceous, surface finely punctulate. Mesosternal crest with lower margin horizontal, anterior edge vertical, angle scarcely mucronate. Length .26 inch; 6.5 mm. Shorter and broader than the preceding species and resembling therefore (*Helochares*) *rotundatus*, Say.

Occurs from Canada westward to Kansas and southward to Georgia.

The four species which follow are all so clearly allied that nothing in addition to the characters in the synoptic table need be given. They are feebly or moderately convex, surface punctulate always more densely and finely on the thorax than the elytra. In color individual variations occur. from testaceous to dark piceous in each species.

P. diffusus, Lec. Proc. Acad. 1855, p. 371.

The largest species of the series. The mesosternal crest is deeply sinuate in front, the angle very acute and prominent forward and not mucronate as in the next species. Length .18–.24 inch ; 4.5–6 mm.

Nebraska.

P. fuscus, Motsch. Bull. Mosc. 1859, III, p. 178.

Smaller than the preceding and with rather finer punctuation, differs principally in the form of the mesosternal crest, which is more acute at tip and with the point strongly bent downwards. Length .16–.18 inch ; 4–4.5 mm.

San Francisco, California.

P. perplexus, Lec. Proc. Acad. 1855, p. 371.

The mesosternal crest in this and the next species is not sinuate on the front edge and the angle formed by the union of that edge and the lower, is broad and not acute as in most of the species which precede. As compared with the other three species of this small group the present one is usually more elongate and transversely more convex, and when perfectly mature the color is almost entirely black, with merely a narrow piceous limb as in *cinctus*.

Length .17–.20 ; 4.5–5 mm.

This species is of almost universal distribution in our country extending from the Middle States to Florida and westward to California.

P. latiusculus, Motsch. Bull. Mosc. 1859, p. 178.

Broader and more depressed than any species of the group, the breadth being always greater than half the width. The appearance of the species recalls *fuscus*. The mesosternal crest is similar to that of the preceding species. Length .18 inch ; 4.5 mm.

California.

P. obtusiusculus, Motsch. loc. cit. p. 179.

Unknown. California.

The second section *Helochares* has been by some students retained as a genus separate from *Philhydrus*, a view which can scarcely be adopted with our species, as the tendency to the obliteration of the carina is very evident in *nebulosus*, while several in the present section have a transverse ridge more or less elevated. The species are as follows :

Prosternum carinate.
  Elytra with ten entire, punctured striæ........ *maculicollis.*
Prosternum not carinate.
  Elytra entirely or in part striate.
    Form very broadly oval ; entirely striate...... *punctatostriatus*
    Form elongate oval ; striate at the sides...... *imbellis.*
  Elytra not striate or with mere traces at apex.
    Elytral punctures coarser toward the apex.... *lacustris, fimbriatus.*
    Elytral punctures obliterated toward apex.... *rotundus.*

P. maculicollis, Muls. Ann. Sc. Phys. Nat. Lyon. 7, 379 ; Lec. Proc. Acad. 1855, 370.

Oblong oval, more attenuate in front, piceous, margin paler, moderately shining. Head dark piceo-testaceous, occiput piceous. Thorax piceo-testaceous, large discal spot nearly black. Elytra with ten entire striæ, coarsely punctured, outer striæ less deep but with coarser punctures, intervals flat very finely and sparsely punctulate. Body beneath and legs piceous. Mesosternum simple, prosterum finely longitudinally carinate. Length .20–.22 inch ; 5–5.5 mm.

This species represents among those of the present section *P. nomatus* of the preceding.

Specimens occur from North Carolina, Missouri, Illinois and Louisiana.

P. punctatostriatus, n. sp.

Broadly oval, piceo-testaceous, gradually paler toward the margins. Head moderately punctured, occiput and middle of clypeus piceous. Thorax finely and densely punctured. Elytra scarcely longer than wide, feebly convex, with ten entire striæ coarsely punctured, the external more coarsely punctured. Intervals flat densely punctulate, the fifth with an irregular row of coarser punctures. Body beneath nearly black. Meso- and prosternum simple. Length .20 inch ; 5 mm.

The most broadly oval species of the genus.

One specimen Fort Tejon, California.

P. imbellis, Lec. Proc. Acad. 1861, p. 341 ; *? dorsalis* (*Hydrob.*) Motsch. Bull. Mosc. 1859, III, p. 177.

Oblong oval, more narrowed in front, piceous, margin paler, surface moderately densely punctulate and shining. Outer four striæ of elytra represented by four entire rows of large punctures, discal striæ obliterated except at apex. Mesosternum with transverse elevated line in front of coxæ. Body beneath piceous, tibiæ somewhat paler. Length .20–.22 inch ; 5–5.5 mm.

The typical specimen is immature and the colors as described are therefore much paler. *Hydrobius dorsalis*, Motsch. agrees exactly in description with this species, and should they be identical the name should be used.

California and New Mexico.

P. fimbriatus, Mels. Proc. Acad. II, p. 101 ; Lec. Pr. Acad. 1855, p. 369 ; *semistriatus*, Zimm. Trans. Ent. Soc. 1869, p. 250.

Oblong oval, similar in color to the preceding, more finely and less densely punctured. Lateral striæ of elytra replaced by sparsely and very irregularly placed coarser punctures, striæ scarcely evident at apex. Mesosternum with faintly elevated transverse carina. Body beneath and legs piceous. Length .20 inch ; 5 mm.

The striæ at apex at best are scarcely visible and at times are entirely obsolete, the apex being punctured like the rest of the surface. The *semistriatus*, Zimm. is an exact reproduction of the Melsheimer type.

Canada and the Middle States.

P. lacustris, Lec. Proc. Acad. 1855, p. 369.

Differs from the preceding by its smaller size, more elongate form, less punctuation and by the surface being nearly evenly punctured, the punctures at the sides and apex of elytra somewhat coarser but not forming rows. Length .14 inch ; 3.5 mm.

Occurs in the Western Canada region.

P. rotundus, Say (*Hydrophilus*), Journ. Acad. V, p. 188; Lec. Proc. Acad. 1855, p. 369 ; *nitens*, Zimm. Trans. Ent. Soc. 1869, p. 250.

Broadly oval, convex, black, shining, sides of elytra feebly explanate and piceous. Surface finely but not very densely punctured, punctures of the elytra coarser and gradually evanescent toward the apex, at sides with a few coarser punctures sparsely and irregularly placed. Body beneath and legs black, mesosternum with a distinctly elevated transverse line. Length .28 inch ; 7 mm.

Resembles superficially *P. cinctus*, but may be known by the smoother surface and absence of any mesosternal crest.

Middle States and North Carolina.

HYDROBIUS. Leach.

The species of this genus are more heterogeneous than those of Philhydrus, and a close resemblance may be noticed in superficial characters between several species of the two genera which will be noticed in their proper places.

Notwithstanding the very odd appearance of *Sperchopsis tesselatus*, Lec., I can find no character by which it may be separated from *Hydrobius*. The genus *Paracymus*, Thoms. appears to be merely a section, as I find the hind femora varying in punctuation in several of the species from the type of *Hydrobius* leading directly to the form seen in *Paracymus*.

Hydrobius may be known from Philhydrus by the fourth joint of the maxillary palpi longer than the preceding and very nearly equal to the second. In the section *Paracymus* the palpi are somewhat shorter and stouter.

The species may be divided in the following manner:

Hind femora densely punctured, pubescent and opaque at base..	*Hydrobius.*
Hind femora sparsely punctured and glabrous.........	*Paracymus.*

The species of HYDROBIUS proper are,

Prosternum carinate or acutely elevated at middle in front.	
Mesosternum simple ; elytral intervals unequally convex.	
Very convex, shining ; elytral intervals smooth..	*tesselatus.*
Depressed, opaque ; elytral intervals scabrous....	*scabrosus.*
Mesosternum prominent ; intervals flat.	
Surface feebly shining ; elytral intervals finely scabrous....................................	*latus.*
Surface shining ; mesosternum strongly cristate ; intervals punctulate.........................	*tumidus.*
Prosternum not carinate.	
Form globose ; elytra with rows of puncture.....	*globosus.*
Form oblong ; elytra more or less striate........	*fuscipes.*

H. tesselatus, Zieg. Proc. Acad. 1844, p. 44; Lec. (*Sperchopsis*) Class. Col. N. A. p. 47.

Pale castaneous, shining, elytra with small piceous spots irregularly disposed. Head coarsely and sparsely punctured. Maxillary palpi with the last joint longer than the third and nearly as long as the second. Thorax two and a half times as wide as long at middle, sides moderately arcuate, at anterior angles strongly arcuate, apex deeply emarginate, base broadly rounded; surface feebly convex, coarsely and sparsely punctured. Elytra broadly oval, nearly as broad as long, very convex transversely and longitudinally, margin explanate: surface striate, striæ coarsely punctured, intervals convex, the alternate intervals beginning with the first more convex at apex. Body beneath black, legs piceous, femora at apical half glabrous. Length .28 inch; 7 mm.

There are no characters by means of which this species can be separated Hydrobius; the palpi are precisely those of well known species of genus. The facies of the species is however totally unlike any thing in the genus. The longitudinal aspect is very convex, the thorax ly deflexed, the elytra more elevated behind the scutellum and then ly descending. Viewed laterally the elytral and thoracic margins are inuous but form an angle with each other. The mesosternum is he prosternum slightly carinate, the carina being much more n front. The color is as described above; the spots of the elytra isposed over the entire surface, there being a broad triangular entirely pale castaneous.

tes, Illinois and Canada, rare.

s, n. sp.

l, more narrowed in front, surface opaque, color piceous. punctured and rugulose. Thorax twice broader than long, y arcuate and slightly narrower in front, surface opaque red and rugulose, and with a shallow broad impression and another on each side very indistinct. Elytra slightly than thorax, sides gradually broader to middle then d to apex, moderately but unevenly convex, sutural nterval near apex, seventh interval at base and entire e convex, surface striate, striæ punctured, intervals Mesosternum simple, prosternum with spiniform beneath and legs piceous, femora pubescent and nly. Length .20–.24 inch; 5–6 mm.

form and sculpture. Specimens before me from d and so much smoother that almost all trace of isappeared from the elytra. The space between gin is very convex, so that the margin is invisi- pture of the species recalls that of *Amphizoa*, a nce, as both occur in the same waters.

gon and Vancouver.

rower in front, piceous black, moderately convex and shining. Head and thorax punctured with coarse and fine punctures intermixed. Thorax similar in form to the preceding species and with more traces of the foveæ there seen. Elytra regularly convex, striate, striæ punctured, less deeply on the disc, and strongly at the sides; intervals flat obsoletely scabrous. Mesosternum slightly prominent, prosternum carinate at its posterior half. Body beneath piceous, legs piceo-rufous. Femora at basal half pubescent. Length .30 inch; 7.5 mm.

Easily known by its broad moderately convex form, from any species in our fauna.

Occurs at Fort Crook, California, with the preceding.

H. tumidus, Lec. Proc. Acad. 1855, p. 372.

A broadly oval very convex species, black and shining, with very slight aeneous tinge. Head and thorax densely and finely punctured. Elytra with striæ of moderate punctures between which are fine punctures rather coarser and less dense than those of the thorax. Body beneath and legs black. Mesosternum with prominent crest, acute and slender at its free angle. Prosternum with very faint carina in front of coxæ and at anterior margin an acute elevation. Length .30–.34 inch; 7.5–8.5 mm.

Not common in the Middle States. Resembles *Philhydrus rotundatus* in form, but readily known by the generic characters. The femora are not at all pubescent, the only remaining pubescence being on the trochanters. This would seem to indicate that the species should be placed in the sub-genus *Paracymus*, but the very close relationship between this species and the following forbids their separation.

H. globosus, Say (*Hydrophilus*), Long's Exped. II, p. 276; Lec. Proc. Acad. 1855, p. 372.

Broader than the preceding species and smoother. The surface is similarly punctured but in each part more finely and obsoletely. Mesosternum with a thick pyramidal crest, broad on its lower face. Prosternum not carinate. Length .30 inch; 7.5 mm.

Occurs from the Middle States to Canada and more common than the preceding. The hind thighs have the basal third opaque and punctured, the opacity extending obliquely outwards on the anterior margin.

H. fuscipes, Linn. (*Dytiscus*), see Mulsant. Col. France, Palpic. p. 122; *seriatus*, *insculptus*, *regularis*, Lec. Proc. Acad. 1855, p. 372.

Oblong oval, piceous black, usually with tinge of bronze, surface moderately punctured, scarcely less densely on the elytra than thorax. Elytra striate, striæ punctured, the third, fifth and seventh intervals with a row of distantly placed coarser punctures. Length .28–.34 inch; 7–8.5 mm.

This species varies greatly as may be seen by consulting the remarks of Mulsant. The variation extends not only to the superficial characters of sculpture but the usually important mesosternal crest. The crest is usually of moderate size and acute at tip, but the size gradually diminishes so that in the form above cited as *regularis*, the crest is reduced to a mere tuberosity. The specimens from Oregon and Vancouver are usually slightly bronzed.

Its distribution extends from England eastward through Europe to Siberia, thence to Alaska and southward to California, and thence eastward to Pennsylvania.

The species referred to the sub-genus *Paracymus* are all small, usually very convex and semi-globose, and may be known as follows:

Body oblong, depressed; mesosternum simple........	*dissimilis.*
Body broadly oval very convex.	
Mesosternum simple.	
Oblong oval, elytra nearly smooth.............	*suturalis.*
Broadly oval, elytra punctured................	*rufiventris.*
Mesosternum protuberant.	
Prosternum simple.	
Color piceo-testaceous, indistinctly punctured..	*infuscatus.*
Black with aeneous tinge, punctured..........	*digestus.*
Prosternum carinate.	
Surface smooth sparsely punctured............	*subcupreus.*
Surface finely alutaceous, indistinctly punctured......................................	*despectus.*

H. rufiventris, n. sp.

Oval, very convex, piceous black, margins piceous, shining. Head and thorax finely and sparsely punctulate, elytra more coarsely punctured especially at the sides and apex. Body beneath and legs rufous. Mesosternum and prosternum simple. Length .09 inch; 2.25 mm.

Resembles *H. digestus*, but is more convex and much less distinctly punctured. Its simple mesosternum will at once distinguish it from all the very convex species in the sub-genus. There is almost no aeneous lustre.

One specimen from Southern Oregon.

H. infuscatus, Motsch. (*Brachypalpus*), Bull. Mosc. 1859, III, p. 177.

Similar in form and sculpture to the preceding. Color piceo-testaceous margins somewhat paler, head black, disc of thorax irregularly clouded with piceous. Body beneath piceous, legs rufo-piceous. Mesosternum with transverse carina, prosternum simple. Length .09 inch; 2.25 mm.

Occurs from California to the Indian Territory.

H. digestus, Lec. Proc. Acad. 1855, p. 373.

Rather less convex than any of the allied species and more coarsely punctured. Surface with very distinct aeneous tinge. Mesosternum feebly prominent, prosternum simple. Body beneath black, legs piceous. Length .09 inch; 2.25 mm.

Middle States and Canada.

H. subcupreus, Say (*Hydrophilus*), Journ. Acad. V, p. 189; Lec. Proc. Acad. 1855, p. 373.

Surface with distinct cupreous tinge, shining, thorax and elytra nearly equally punctured. Mesosternum distinctly protuberant, prosternum finely carinate. Body beneath and legs dark rufo-piceous. Length .06–.08 inch ; 1.5–2 mm.

Middle States and Canada to California and Oregon.

H. despectus, Lec. New Species, p. 25.

Closely resembling *subcupreus* but smaller and transversely more convex. Surface distinctly aeneous, very minutely alutaceous and with minute punctures sparsely placed. Mesosternum with short acute protuberance, prosternum finely carinate. Length .06 inch ; 1.5 mm.

Occurs in Pennsylvania and Illinois.

H. dissimilis, n. sp.

Oblong, sub-depressed, dark piceo-testaceous, margins paler. Head piceous moderately densely punctulate. Thorax more than twice as wide at base as long, sides feebly arcuate and slightly narrowed to apex, feebly convex, punctured similarly to the head ; color piceous, margins testaceous. Elytra oblong, parallel, feebly convex, with faint rows of punctures more distinct at the sides and apex, between which are fewer punctures, coarser than those of the thorax but less densely placed.

Body beneath piceous, femora piceous, tibiæ piceo-rufous. Mesosternum and prosternum simple. Length .10–.12 inch ; 2.5–3 mm.

Two specimens, San Francisco, California.

H. suturalis, Lec. (*Limnebius*), Proc. Acad. 1866, p. 366.

Oblong oval, piceous black, shining, with very faint bronze tinge. Head and thorax scarcely punctulate except under very high power, sides of thorax testaceous and nearly transparent. Elytra at margins dark piceo-testaceous, surface almost entirely impunctured. Body beneath black, legs rufous. Mesosternum simple, prosternum in front of coxæ not carinate. Length .06–.08 inch ; 1.5–2 mm.

In this insect, as in most of the species of Hydrobius, the males have the sixth segment slightly visible at tip. In one specimen which I have examined there is an undue prominence of that segment possibly owing to injury, but in no specimen can there be seen any trace of a seventh segment. The species is therefore referred to Hydrobius from which it does not differ.

Middle States and Canada.

LIMNOCHARIS. Horn.

L. piceus, Horn. Trans. Am. Ent. Soc. IV, 1872, p. 144.

Oval, more attenuate behind, piceous, sparsely pubescent. Thorax finely and sparsely punctulate. Elytra finely alutaceous. Body beneath black, densely punctulate, sparsely pubescent. Legs testaceous. Length .06 inch ; 1.5 mm.

One of the most minute species in our fauna. The eight segments of the abdomen serve at once to distinguish this genus from any one previously known.

Occurs near Fort Crook, California.

The following genus presents so many characters at variance with our genera of the tribe *Hydrobiini* that it seems necessary to place it by itself as a distinct sub-tribe. From all *Hydrophilidæ* known to me it differs in having the genæ at the sides broadly dilated and the labrum entirely concealed beneath the clypeus in front. Excepting these two characters it is a true *Philhydrus*, with the last joint of the tarsi more elongated than usual.

HELOPELTIS, n. g.

Mentum transversely quadrate, slightly concave at middle, on each side an oblique impression continuing on the sub-mentum where the two join.

Maxillary palpi very long and slender, nearly as long as the head and thorax, second joint one-fifth longer than the third, third and fourth equal.

Labial palpi short, not longer than half the terminal point of the maxillary palpi, and with the terminal joint shorter than the preceding.

Head broad, clypeus broadly rounded, genæ broadly dilated at the sides and half dividing the eyes; labrum concealed beneath clypeus. Middle and hind tarsi with the first joint small, second equal to the two following, which are very short, fifth as long as all the preceding together.

Anterior tibiæ with outer edge not spinulose.

Thorax and elytra broadly margined, margin extending beyond the tip of the abdomen.

H, larvalis, n. sp.

Oblong, depressed, dark piceo-testaceous, opaque. Head opaque obsoletely rugulose, in front piceo-testaceous, occiput piceous. Thorax nearly three times as wide at base as long, sides moderately arcuate and feebly narrowed anteriorly, apex emarginate, base at middle broadly but feebly sinuous, surface opaque, obsoletely scabrous, smoother at the sides, margin slightly explanate. Scutellum elongate triangular. Elytra oblong, sides feebly arcuate, margins broadly produced and somewhat explanate, surface ten striate, the outer two indistinct, striæ gradually obsolete toward apex, punctulate, intervals flat, finely alutaceous and obsoletely punctured, color piceo-testaceous, paler at the margins and irregularly marked with small piceous spots. Body beneath piceous, opaque. Mesosternum and prosternum simple. Femora piceous, opaque and pubescent, apex smooth. Tibiæ piceo-rufous. Length .22 inch; 5.5 mm.

The broadly produced margins of the thorax and elytra give this insect a peculiar appearance recalling that of *Peltis feruginea*, as well as of the larvæ of some of our Elmidæ.

Two specimens are known to me, one from Louisiana in the cabinet of Dr. Leconte, and one from Sonora in my own. A closely allied if not identical species occurs in Cuba.

THE NON-PERIODIC DISTRIBUTION OF HEAT IN THE ATMOSPHERE.

BY LORIN BLODGET.

(*Read before the American Philosophical Society, February* 21, 1873.)

The time has at length arrived when we can with some probability of success, open the inquiry as to the causes of the remarkable facts of the Non-Periodic distribution of heat in the atmosphere of the temperate climates; the necessary basis of observed facts being afforded in the extensive series of means of temperature published in various works, chiefly the War Department volumes; and in the recent and most valuable system of the Signal Service.

These extreme non-periodic changes are very remarkable on both sides, that is, those of excessive heat in summer, and those of excessive cold in winter, or in the colder months, since they often occur in other than the technical winter months. So great are the consequences in simply the sanitary point of view, that the National Health Association recently formed, has made them the specific subject of inquiry: and at New York the highly intelligent direction of the Health Commissioners has been directed toward the introduction of special protective measures of a local character to avert the fearful mortality which these periods of excessive heat cause in that city.

In a practical point of view the most urgent desire exists to ascertain whether these excesses, especially of heat, can be indicated or foreshadowed by telegraphic or other agency; whether warning can be given, and care for the preservation of life enjoined. In the extreme 'Northwest the destruction of life from violent cold is as great as that in New York from extra-tropical heat; and admirable as many features of the present Signal Service are, it does not at present give us any efficient action on the specific point of preparing us for either of these extremes.

In a philosephical point of view the inquiry is broader and more comprehensive. It is a great enlargement of the inquiry in regard to storms, introducing new elements and more important calculations. It appears to be broader in its scope than even the atmospheric circulation which is now so well established, and through which most of the phenomena of the evaporation and precipitation of atmospheric moisture are regularly ordered and instituted. Storms are but incidents of this system of circulation, with its consequences of evaporation in the tropics, and precipitation in the temperate latitudes. We can set bounds to it, and fix its constants with a fair degree of accuracy. The atmospheric movements, whether superficial, or in the superior strata, can easily be reduced to a resultant, and their significance determined almost as positively at the 40th parallel, as can that of the trade winds on the borders of the tropics. The constants of atmospheric precipitation are also of comparatively easy determination, and the sea of water falling in rain and snow can be measured and its depth determined with a close approximation to accuracy. So also of the averages or fixed constants of heat; there is little difficulty in reducing all the irregularities disclosed in successive months, seasons or years to determinate values, fixing the isothermal illustration with reasonable precision.

But the great single non-periodic variations of heat are more difficult to grapple with than any other phenomena of their class. They are not traceable, as storms are, from any point of natural initiation, through a moving path of growth to maximum proportions, followed by regnal and natural exhaustion until the equilibrium is restored. An excess of moisture arising in the atmospheric circulation at a colder latitude must be precipitated from the air which can no longer sustain it; and in the course of this natural and inevitable condensation, all the known phenomena of storms are developed. But there are changes of the measure of heat which occur in quite as large a measure wholly independently of any such phenomena, as they do in concurrence with them. Indeed, there are at times extraordinary depressions of temperature departing widely from the normal measures for the month or season in which they occur, which appear to *strike down*—not to be transferred along the surface with any atmospheric movement—and to force from the air every vestige of contained moisture; as if some external compressing force had been applied.

As I have proposed only to open the subject at the present time, I beg to offer a few propositions for consideration rather than to suggest that they are even preliminarily proved. It is a very laborious work to investigate the subject through the rigid processes of induction which can alone establish positive principles. It is easier to indicate some negative determinations; and these are so important, and so much at variance with the analogies of change in the atmospheric problems heretofore investigated, as to induce me to anticipate more conclusive results and present them in this paper. The following are the propositions;

1. The greater non-periodic changes in the measure of heat in the temperate climates of the North American Continent are not connected with or dependant upon the system of atmospheric circulation of these latitudes; nor on the incidents of this system, in the evaporation and precipitation of moisture, nor on the greater phenomena of such precipitation in the form of local or general storms.

2. There is no evidence of movement in these greater changes, either with or against the course of movement belonging to the ponderable elements of the atmosphere.

3. The periods of extreme cold do not come from, or connect with like conditions at the North; they are not transferred from the North Southward; often the reverse is the case, and unusual mildness prevails in observed portions of British America, at the time that almost Arctic severity prevails in much lower latitudes and in various parts of the Northern and Central States.

4. The periods of extreme heat do not come from, or connect with periods of extreme heat at the South.

It is often much cooler at Charleston, Key West, and elsewhere at the South than it is at Baltimore or New York in these cases of excessive heat. And a whole month, as well as a shorter period may exhibit such comparatively cool weather at the points from which it might be inferred that the heat would be transferred to us. In fact, at Charleston and Savannah, the intense heat of the last summer at New York and the North were unknown !—a mean of 85° at the North being reduced there to a mean of 81½° only.

5. These more striking non-periodic extremes, both of heat and cold, appear to be instituted at the districts where they are felt, by or through some superior and extraneous agency, the elements of which are at present extremely difficult of determination.

I beg for the present merely to submit these propositions, as being indicated only, not proved, although much time and observation have been given by me to the consideration of the subject. I shall beg also to submit at an early day, the numerical elements of the investigation as so far conducted.

OSCILLATORY FORCES IN THE SOLAR SYSTEM.

By Pliny Earle Chase, Professor of Physics in Haverford College.

(*Read before the American Philosophical Society, February 7th,* 1873.)

All material motion seems to be determined by tendencies to equilibrium between elastic, or centrifugal, and attractive, or centripetal forces. It may, therefore, be presumed that every molecular motion can be so connected by simple equations, with solar force, as to furnish an almost endless variety of methods for estimating the Sun's mass and distance.

The solar radiating forces (luminiferous, caloriferous, etc.), are supposed to move with uniform velocities in straight lines. Gravitating motion is uniform only in circular orbits. We may, therefore, reasonably look for the circular ratio, π, among the conditions of planetary equilibrium. The influence of that ratio in positing alternate planetary orbits, is shown in the following table, each of the theoretical terms being obtained by dividing the preceding term by π.

Cardinal Positions in the Solar System.

	Theoretical.	Observed.
Neptune, mean	30.04*	30.04
Saturn, "	9.56	9.54
Mars, major axis	3.04	3.05
Earth, perihelion	.97	.98
Mercury, "	.31	.31

* $\frac{\pi^n}{32}$. If π^n represents the time of revolution in a circular orbit, $\pi^n \div \sqrt{32}$ represents the time of fall from the circumference to the centre.

The intermediate planets are arranged at distances proportioned to orbital times at reciprocal centres of oscillation and suspension. Jupiter's mean distance is nearly $3^{\frac{3}{2}}$ × Earth's; that of Uranus, $(3^{\frac{3}{2}})_2$ × that of Venus.

INTERMEDIATE PLANETARY POSITIONS.

	Theoretical.	Observed.
Uranus	19.30*	19.19
Jupiter	5.20	5.20
Venus	.72	.72

The aphelion distances of Neptune, Uranus and Saturn, are at one extremity and centres of oscillation of a simple pendulum. The distance of Uranus, or the mean length of the pendulum, represents the length of a light undulation which is synchronous with a planetary oscillation at the Sun's surface. Jupiter's perihelion distance is one-sixth of Neptune's. The significance of this coincidence is the more interesting, in view of Stockwell's discovery that the mean perihelion longitudes of Jupiter and Uranus differ by exactly 180°, and, therefore, Jupiter's perihelion is properly comparable with the aphelion of Uranus.

The following table shows the accordance of these relations.

NODAL POINTS OF PLANETARY OSCILLATION.

	Theoretical.	Observed.
Neptune, mean aphelion	30.38	30.30
Uranus, " "	20.26	20.05
Saturn, " "	10.13	9.94
Light, Undulation	20.26	20.20
Jupiter, mean perihelion	4.96	4.98

The principal planetary masses are so placed as to exhibit simple relations between their orbital moments of inertia. The mean moments of Jupiter and Saturn are nearly equal; Neptune's is about π times as great as that of Uranus; the sum of the moments of Venus and Mars is about two-thirds as great as that of Earth and Mercury; the centre of inertia of the planetary system is within the orbit of Saturn.

PLANETARY INERTIA.

Jupiter, mean moment	258,200
Saturn, " "	259,627
Uranus, " " × π	482,378
Neptune, " "	480,439
$\frac{2}{3}$ (Earth + Mercury)	21.5
Venus + Mars	20.8
Mean centre of inertia	9.35
Mean distance of Saturn	9.54

* .955 x 20.20. See next table.

ESTIMATION OF SOLAR MASS AND DISTANCE, FROM THE EQUILIBRIUM OF ELASTIC AND GRAVITATING FORCES.

BY PLINY EARLE CHASE.

(*Read before the American Philosophical Society, Feb. 7th,* 1878.)

The lightest and most elastic gas must be kept in mean position, under conditions of equilibrium between the forces of gaseous expansion and of virtual fall towards the centres of the Sun and the Earth. In cases of explosive disturbance, the character and range of the resulting oscillations must depend on those conditions of equilibrium.

In order to ascertain the approximate ratio of terrestrial to solar gravity, let us suppose the mass of the Earth concentrated in a single point, c, at its centre of gravity.

Let $x =$ distance from c at which the satellite and planetary velocities would be equal.

$\zeta = 2x$; $d = 2\zeta$; $r =$ Earth's radius.

g, g^0, $g^1 =$ force of gravity at ζ, r, and x, respectively.

$v =$ orbital velocity of earth, or satellite velocity at x.

$r_{\prime} =$ distance of Sun from Earth.

$\mu =$ mass (Sun $\div$ Earth).

$T^d =$ time of actual fall through a diameter d, or time of orbital revolution at the mean distance x.

$\tau^\delta =$ time of actual fall through a diameter δ, or time of virtual fall through a distance $= \delta$ at ζ.

$\tau_1{}^\delta =$ time of virtual fall through a distance $= \delta$, at r.

Then by the laws of gravitation, we have the proportion

$$T^d : \tau^\delta :: d^{\frac{3}{2}} : \delta^{\frac{3}{2}} :: \tfrac{\pi}{2}\sqrt{\frac{d}{g}} : \sqrt{\frac{2\delta}{g}}$$

$$1 : \left[\frac{\delta}{d}\right]^{\frac{3}{2}} :: \frac{\pi}{\sqrt{8}} : \left[\frac{\delta}{d}\right]^{\frac{1}{2}}$$

$$d : \delta :: \pi : \sqrt{8}$$

$$T^d \propto \tau^\delta \propto \sqrt{\frac{1}{g}}$$

The six most recent experimenters upon the explosive force of hydrogen, have obtained results with a limiting variation of about 3½ per cent. from the mean. Four of the experimenters agree within an extreme difference of less than two-fifths of one per cent., the mean of their results differing from the general mean by less than one-fifth of one per cent. This agreement is much closer than any hitherto obtained by astronomical observations.

According to the experiments referred to, the explosive force of H_2O may be represented by a virtual fall through a mean δ of 1017.01 miles, in a $\tau_1{}^\delta = \sqrt{\frac{2\delta}{g^0}} = 578.5$ seconds. The best approximate values of δ are those of

Dulong	D	1015.97	miles.
Hess	H	1017.40	"
Crawford	C	1052.73	"
Grassi	G	1013.72	"
Favre and Silbermann	F	1013.60	"
Adams	A	988.63	"
Mean of D, H, G, F		1015.18	"
General Mean		1017.01	"

If we assume the correctness of the general mean, $d = \delta \times \sqrt{\frac{\pi}{8}} = 1129.61$; $\tau^{\delta} = \tau_1^{\delta} \times \sqrt{\frac{g^0}{g}} = 578.5 \times \frac{1129.61}{7925.64} = 82.45$ seconds; $x = d \div 4 = 282.4$; $T^d = \tau^{\delta} \div \left[\frac{\delta}{d}\right]^{\frac{3}{2}} = 96.515$ seconds; $v = 2 \pi x \div T^d = 18.3844$ miles; $\eta = v \times 1$ year (in seconds) $\div 2 \pi = 92{,}338{,}000$ miles; $\mu = \eta \div x = 326{,}980$.

This approximation is subject to correction for possible imperfect elasticity of hydrogen, æthereal resistance, and orbital eccentricity. From various considerations I am inclined to believe that the aggregate corrections for the value of $\gamma_{,}$, cannot exceed to one and a-half per cent. of the above amount.

NOTE ON PLANETO-TAXIS.

By Pliny Earle Chase.

(*Read before the American Philosophical Society, March 7th,* 1873.)

I am not aware that any reason has ever been assigned for the planetary harmony which is formulated in "Bode's Law," or that any attempt has been made to show that the failure of the analogy, in the case of Neptune, is really only one of those apparent exceptions which serve to establish general rules on a firmer basis.

The many evidences which I have already adduced, of simple relationships between planetary positions and centres of oscillation, seem to furnish the needed data for verifying the law, as a simple and natural resultant of equilibrating forces, and not a mere accidental coincidence. If a nebulous mass were set in rotation, each of its equatorial radii might be regarded as a simple pendulum, with a tendency to vibrate in the same time as its centre of oscillation, which tendency might be expected to produce an aggregation at that centre.

If we start from the circularly divided radius next within the orbit of Mercury, $\left(\frac{\pi}{32} r = .0982\right)$, and add multiples of the next following radius $\left(\frac{\pi^2}{32} r = .3085\right)$, we may form the first series (A) in the following table, each term of which is within the limits of secular variation. The second and third series (B, C,) represent the mean perihelion and aphelion planetary distances. The fourth series (D) gives the mean distances; and the fifth (E) is derived from the first by simple systematic modifications.

THEORETICAL AND OBSERVED PLANETARY POSITIONS.

		A	B	C	D	E
$\frac{\pi}{32}$		.098				
$\frac{\pi + \pi^2}{32}$	☿	.407	.319	.455	.387	.386
$\frac{\pi + 2\pi^2}{32}$	♀	.715	.698	.749	.723	.715
$\frac{\pi + 3\pi^2}{32}$	⊕	1.024	.966	1.034	1.000	.998
$\frac{\pi + 5\pi^2}{32}$	♂	1.641	1.403	1.642	1.524	1.520
$\frac{\pi + 9\pi^2}{32}$	✱	2.875	2.201	3.420	2.810	
$\frac{\pi + 17\pi^2}{32}$	♃	5.342	4.978	5.427	5.203	5.209
$\frac{\pi + 33\pi^2}{32}$	♄	10.278	9.078	10.000	9.539	9.525
$\frac{\pi + 65\pi^2}{32}$	♅	20.150	18.322	20.043	19.183	19.153
$\frac{\pi + 97\pi^2}{32}$	♆	30.022	29.735	30.339	30.037	30.021

I have already spoken of corrections that seemed to be requisite in many of my analogies, on account of planetary eccentricities. If the A series be divided by a mean proportional between the average (major ÷ mean) radii vectores of Earth and Jupiter, the results will differ less from the actual planetary positions than those given by Bode's Law. The remarkably close approximations of the E series were obtained by using E^0, $E^{\frac{1}{3}}$, $E^{\frac{2}{3}}$, E^1 as divisors, (E — 1.079065 — average $\frac{\text{major}}{\text{mean}}$ radius vector of Mars.*)

The planetary deviations are grouped in pairs, and also in exterior and interior systems. Neptune and Venus are not materially shifted; Mercury and Uranus are divided by $E^{\frac{2}{3}}$; Earth and Jupiter by $E^{\frac{1}{3}}$; Mars and Saturn by E^1. The ratios of the divisors to radius vector, time, and velocity, may have important bearings.

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*The values of the mean planetary eccentricities were taken from Stockwell's recent paper on "Secular Variations of the Elements of the Orbits of the Eight Principal Planets."

The theoretical distance of Neptune (in column A) appears to be an *exact* mean proportional between Mercury's theoretical distance and the modulus of light. That modulus, according to this determination, is 476,198 × Sun's radius; according to Struve's value of the constant of aberration, it is (475,969.23 ± 258.45) × solar radius.

The theoretical series is symmetrical, in having three terms in arithmetical progression at either extremity. This analogy is more nearly carried out in the actual positions of the three exterior planets, which have been regarded as exceptional, than in those of the three interior planets, which have been considered normal.

The theoretical positions of Mercury and Venus, are at centres of direct and reverse oscillation between Earth and $\frac{\pi}{32}$; those of Uranus and Saturn, at similar centres between Sun and Neptune.

The successive doubling of the differences, places each of the theoretical intermediate planets at a centre of oscillation between the next inferior and the next superior planet.

The deviations from theoretical positions, in consequence of mutual planetary disturbances, distribute the planets in various symmetrical ways.

The exponents of the divisor, E, are arranged symmetrically in pairs. ($\frac{2}{3}$, 0 ; $\frac{1}{3}$, 1 ; $\frac{1}{3}$, 1 ; $\frac{2}{3}$, 0.)

The four central planets are grouped, by their divisors, in alternate pairs; Earth, Jupiter; Mars, Saturn.

The four terminal planets are similarly grouped; Neptune, Venus; Uranus, Mercury.

If the division by π be thrice repeated, below the theoretical position of Mercury, we obtain, very nearly, $(\pi-1)$ × solar radius, or the diameter of the circle described by the centre of gravity of Sun and Jupiter.

ROTATION OF THE SUN AND THE INTRA-ASTEROIDAL PLANETS.

By Pliny Earle Chase.

(*Read before the American Philosophical Society, March 7th,* 1873.)

The well known tendency to synchronism in concurrent vibrations, has encouraged me to look for some significant harmony between the lengths of solar and planetary days and times of fall to the centre of the system.

The middle term in my series of alternate planetary distances, differs from the others in having a multiple significance, representing, as it does, a mean position in the asteroidal belt and the orbital major axis of Mars. It has also simple relationships to the distances and rotation-times of the intra-asteroidal planets, which serve to connect the diurnal with the annual motions, and both with the equilibrating forces of the Sun.

Since the velocities of falling and oscillating bodies are proportioned to the times of actual or virtual fall, rotary and orbital velocities can be compared by a simple and natural hypothesis. Let

ρ = modulus of rotation, or distance from Sun through which a planet would fall in τ^f. $\rho^{\frac{3}{2}} \propto \sqrt{32} \times \tau^f$

τ^f = time of fall which will satisfy the proportion.

$$\tau^f : \tau^r :: V : v$$

τ^r = length of day.

V = orbital velocity.

v = equatorial velocity of rotation $= \dfrac{2\pi r}{\tau^r}$

$\Delta = \dfrac{d}{\delta} = \dfrac{\pi^*}{\sqrt{8}}$

Substituting for v its value, in the above proportion, and reducing, we obtain the equation

$$\tau^r = \left(\frac{2\pi r \tau^f}{V}\right)^{\frac{1}{2}}$$

The Earth being the controlling planet of the intra-asteroidal system, it is not surprising that its radius vector and the factor of equilibrium, Δ, both enter into the values of ρ. $2\Delta^4 = \dfrac{\pi^4}{32}$, and $\dfrac{\pi^4}{32} \times$ Earth's mean radius vector = major axis of Mars, which in its turn = mean radius vector $\div$ modulus of rotation of Mercury; Earth's ρ = its perihelion distance: the moduli of rotation for Venus and Mars are, respectively, Δ and $\Delta^2 \times$ Earth's modulus; Sun's modulus = mean distance of Uranus = distance of Neptune's radial centre of oscillation. The accordance of these theoretical values with the actual values, is shown in the following table:

MODULI AND TIMES OF ROTATION.

	ρ	Theoretical τ^r.	Observed τ^r.
Mercury	2.653	24.321	24.091
Venus	1.093	23.342	23.357
Earth	.983	23.972	23.934
Mars	1.213	24.537	24.622
Sun	19.183	603.138	604.007

The solar modulus serves to connect the synchronism of light-oscillation at Neptune and planetary oscillation at Sun with the light-velocity which would be communicated by the action of solar-superficial gravity in a half-rotation.

The modulus of rotation for Mercury (2.653; cfr. Juno, 2.671; $\frac{1}{2}$ Jupiter, 2.601; $\frac{8}{3}$ Earth, 2.667), may, perhaps, indicate a fall from the middle of the asteroidal belt, since the time when Mars and Venus were thrown off from the nebulous earth. Or, inasmuch as Δ^3 is the aphelion distance of a planet with a major axis equivalent to Mercury's modulus, and eccentricity equivalent to the mean of the eccentricities of the other interior planets, Mercury and Mars may have condensed simultaneously from an intra-asteroidal ring, of a thickness corresponding to the difference between their rotation-moduli. $\triangle^4$ would then indicate the primary nucleus of the first intra-asteroidal nebulous ring, or the mean distance of Mars; $\triangle^3$, the perihelion of Mars; $\triangle^2$, $\triangle^1$, $\triangle^0$, the moduli of rotation of Mars, Venus, and Earth.

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* See foregoing note on the "Estimation of Solar Mass and Distance."

PLANETARY RELATIONS TO THE SUN-SPOT PERIOD.

By Pliny Earle Chase.

(*Read before the American Philosophical Society, March 7th,* 1873.)

Stockwell's discussion of Secular Variations has furnished an unexpected confirmation of my suggested accordance between Jupiter's mean perihelion distance, the planetary centre of gyration, and the radius vector of the disturbing force which occasions the mean sun-spot cycle of 11.07 ± years.

In my previous paper (*ante*, xii, 410) I made the comparisons with the present eccentricity of Jupiter. If we take the *mean* eccentricity (.04316), Jupiter's mean perihelion is in the precise orbit of the disturbing force, provided the disturbance-period is 11.11 years. The factor of Jupiter's variation from Bode's Law $\left[(1.079)^{\frac{1}{3}}\right]$ is also the factor of the perturbation variation from the centre of planetary gyration ($5.101 \div 1.0257 = 4.973$).

Kirkwood has shown the approximate commensurability of the Wolfian cycle with 46 years of Mercury, 18 years of Venus, 11 of Earth, 6 of Mars, and 1 of Jupiter. I have introduced these five periods in the following table, together with (6) $\frac{3}{8}$ of Saturn, (7) $\frac{2}{15}$ of Uranus; (8) $\frac{1}{15}$ of Neptune; (9) $\frac{2}{3}$ year of the mean centre of inertia of Jupiter's aphelion and Saturn's perihelion; (10) $\frac{2}{3}$ do. Jupiter's perihelion and the aphelion of Uranus; (11) $\frac{3}{7}$ do. Saturn's aphelion and Uranus' perihelion; (12) $\frac{1}{5}$ do. Saturn's perihelion and Neptune's aphelion; (13) $\frac{1}{12}$ do. Uranus' aphelion and Neptune's perihelion.

APPROXIMATIONS TO THE WOLFIAN CYCLE.

1.	46	years of	Mercury	4046.63
2.	18	"	Venus	4044.60
3.	11	"	Earth	4017.86
4.	6	"	Mars	4121.86
5.	1	"	Jupiter	4332.58
6.	$\frac{3}{8}$*	"	Saturn	4034.71
7.	$\frac{2}{15}$	"	Uranus	4091.78
8.	$\frac{1}{15}$	"	Neptune	4008.45

* Earth's radius vector, divided by $\frac{3}{8}$ = Mercury's modulus of rotation.

9.	$\frac{2}{3}$ inertia period of Jupiter and Saturn	4038.49
10.	$\frac{2}{3}$ " " " Uranus	4060.86
11.	$\frac{2}{7}$ " " Saturn and "	4046.08
12.	$\frac{1}{5}$ " " " Neptune	4071.89
13.	$\frac{1}{12}$ " " Uranus and "	4027.52
14.	Kirkwood's period	4043.43
15.	Mean	4070.48

If we substitute $\frac{14}{15}$ of Jupiter's year (4043.74) for the fifth number in the above table, the mean will become 4049.85, the time of planetary revolution at Jupiter's mean perihelion being 4057.65 days. The fractional coefficients of the exterior planetary years will also be nearly commensurable, $2 \times \frac{14}{15}$ being nearly equivalent to $5 \times \frac{3}{8}$, $14 \times \frac{2}{15}$, and $28 \times \frac{1}{15}$.

The relations of Uranus to the centre of oscillation of Neptune's radius vector and to the synchronous vibrations of light and gravity, lend interest to the following table. The elements introduced are the mean aphelia of the three outer planets, the mean perihelion of Jupiter, and the mean distances of the inner planets.

APPROXIMATE COMMENSURABILITY OF PLANETARY DISTANCES.

$\frac{2}{3}$ Neptune's mean aphelion	20.226
Uranus' " "	20.043
2 × Saturn's " "	20.
4 × Jupiter's mean perihelion	19.913
13 × Mars	19.808
20 × Earth	20.
28 × Venus	20.253
52 × Mercury	20.129
Average	20.046

The almost precise accordance of the general mean with the aphelion of Uranus, the diminution of values towards the centre, and the grouping by pairs, are all indicative of harmonic laws which may serve not only to explain the sun-spot cycles, but also many of the other phenomena of our system.

RELATIVE VELOCITIES OF LIGHT AND GRAVITY.

BY PLINY EARLE CHASE.

(Read before the American Philosophical Society, March 7th, 1873.)

The only approximate estimate of the velocity of gravity that has ever been made, appears to be that of La Place, who showed that it must be at least six million times as great as that of light. The mutual action and reaction of centrifugal and centripetal forces may, perhaps, furnish means for its ultimate satisfactory determination, to which end the following considerations may be regarded as preliminary.

I have already shown (*ante*, xii, 406) that the radiating force at the Sun's surface, is directly comparable with the gravitating force at the surfaces of the Earth and Jupiter. This fact has suggested a reference of balancing forces to the distance (δ) from the Sun's centre at which the luminous and gravitating velocities would be equal, similar to my previous reference of the gravitating forces of different masses, to the distance from a planetary centre at which satellite and orbital velocities would be equal.

If we take Norton's values of the astronomical elements, and suppose the Sun's mass concentrated in a single point,

$$\delta = \frac{425,061.5}{(183,454 \div 265.52)^2} = .89041 \text{ miles.}$$

The circumference in which gravity would give a uniform velocity equivalent to that of light, is, therefore, 5.5946 miles, and each circular oscillation would be performed in $\frac{5.5946}{183,454} = \frac{1}{32791}$ second. The time of solar rotation, (2,174,425 seconds) is equivalent to $(2,174,425 \times 32791 =)$ 71,391,570,175 primary gravity-oscilliations (β).

The number of centres of luminous undulations in any sphere is proportioned to $\pi^3 r$; if we divide $\pi^3 \delta$ by β we obtain .0000245 in., which corresponds very closely with the wave length of the extreme red ray (.0000266).

Again, if we divide the time of solar rotation by $\pi \times$ the square of the time of a primary gravity-oscillation, we obtain

$$\left(2,174,425 \div \frac{\pi}{(32,791)^2} =\right) 744 \times 10^{12},$$

which corresponds nearly with the number of oscillations of the extreme violet ray in one second (727×10^{12}).

THE GAMUTS OF SOUND AND LIGHT.

BY PLINY EARLE CHASE.

(*Read before the American Philosophical Society, March* 21, 1873.)

The evidences of planetary annuli of balancing forces may be still further supplemented by a comparison of the visible with the audible waves.

Various correspondences have been pointed out between the scale of color and musical scales, but Ponton has shown (Quarterly Journal of Science, No. XXXVII, pp. 91–103) that the agreement is not so close as has been sometimes supposed. There are, however, some interesting relations which seem to show an underlying harmonic law, which is partially obscured by want of homogeneity, either in the solar atmosphere, or in the æthereal medium, or in both.

Physical charts of the thermal equator give a mean temperature of about 82° F. Taking Ganot's (Dulong's) formula,

$$v = 1093\,(1 + .003665\,t)^{\frac{1}{2}},$$

and substituting the value $t = \frac{5}{9}\,(82° - 32°) = 27\frac{7}{9}°$, the mean equatorial velocity of sound should be 1147.3 ft. per second. The wave-length of the lowest *do* $\left(C_{-3}\right)$ is, therefore, $1147.3 \times 12 \div 16 = 860.5$ inches.

The following table gives the number of vibrations and the wave lengths of the fundamental note, for each of the first twenty-six octaves.

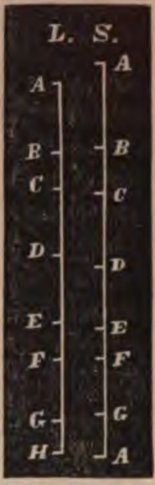
I. TABLE OF MUSICAL OCTAVES.

Note.	Vibrations per Second.	Wave Lengths.
C_{-3}	16	860.5
C_{-2}	32	430.25
C_{-1}	64	215.125
C	128	107.5625
C_2	256	53.78125
C_3	512	26.890625
C_4	1024	13.4453125
C_5	2048	6.72265625
C_6	4096	3.36132812
C_7	8192	1.68066406
C_8	16384	.84033203
C_9	32768	.42016601
C_{10}	65536	.21008300
C_{11}	131072	.10504150
C_{12}	262144	.05252075
C_{13}	524288	.02626037
C_{14}	1048576	.01313018
C_{15}	2097152	.00656509
C_{16}	4194304	.00328254
C_{17}	8388608	.00164127
C_{18}	16777216	.00082063
C_{19}	33554432	.00041031
C_{20}	67108864	.00020515
C_{21}	134217728	.00010257
C_{22}	268435456	.00005128
C_{23}	536870912	.00002564

The wave length of C_{23} corresponds very closely with that of the Fraunhofer C line (.00002586), and the corresponding octave is therefore directly comparable with the prismatic spectrum. Table II. contains a comparative exhibit of the wave-lengths, in hundred-millonths of an inch, of the twenty-sixth musical octave, with those of the Fraunhofer lines according to Angström's measurements, and the accompanying diagram graphically illustrates the comparison.

II. WAVE-LENGTHS OF LIGHT AND SOUND.

Fr. Lines.	Length.	Musical Notes.	Length.
A	2997	A	3077
B	2707	B	2735
C	2586	C	2564
D^{γ}	2322	D	2279
E	2076	E	2051
F	1915	F	1923
G	1697	G	1709
H_2	1550	A	1538
Mean, Arith.	2231	Mean, Arith.	2234
" Geo.	2180	" Geo.	2180



By a singular fortuitous coincidence, the same names have been given to the principal nodes in the luminous octave, and to the corresponding notes of the Diatonic Scale. Although the differences between the analogous wave-lengths are too great to be strictly harmonized with any known musical scale there can be no hesitation in any single instance, as to the proper notes for comparison. The tendency to minor intervals in the spectrum, the closeness of the agreement at F, which has been called "the key-note of nature," and the equality of the means, may, possibly, have something more than a merely curious significance. Analogies of this description, based on the lines which are most prominent, are much more satisfactory than those between the more minute and more numerous microscopic lines.

All musical scales being more or less artificial, one might, perhaps, be constructed, which should agree more closely with the luminous gamut than any hitherto proposed. Table III. exhibits some interesting features of reciprocal resemblances to Poole's "Double Diatonic Scale." The left hand column gives the number of vibrations of the successive musical notes; the middle column, the wave-lengths of the Fraunhofer lines; the right hand column, a set of wave-lengths in which the intervals are the same as Poole's but differently arranged and not fitted for harmony.

III. LUMINOUS AND DOUBLE DIATONIC SCALES.

Poole's Notes.	Fr. Lines.	False Scale.
3096	2997	3000
2709	2707	2700
2580	2586	2571
2322	2322	2314
2064	2076	2057
1935	1915	1928
1741	1697	1714
1548	1550	1543

In six out of eight notes, the agreement with Poole's Scale is remarkably close. The differences from the False Scale are all slight, in no case exceeding one per cent., but this merely shows that the *successive* lines, are arranged nearly at such intervals as *may be* used in harmony. Table IV. shows more satisfactory agreements between remoter notes, in Table II.

IV. ACCORDANT INTERVALS IN LIGHT AND SOUND.

	Light.	Sound.	
BF	1.413	1.422	BG ÷ FG — CE and 2 Semitones.
BG	1.595	1.600	$\frac{8}{5}$ — Minor Sixth.[*]
CE	1.245	1.250	$\frac{5}{4}$ — Major Third.
CA	1.669	1.667	$\frac{5}{3}$ — Sixth.[†]
DE	1.118	1.111	$\frac{10}{9}$ — Minor Tone.
EA	1.341	1.333	CA ÷ CE — Fourth.
FG	1.129	1.125	$\frac{9}{8}$ — Major Tone.

Ponton's explanation of such harmonies as these, "that the ratios are those of the respective amounts of *vis inertiæ* possessed by the vibrating atoms which originate the lines,"[‡] seems quite satisfactory; but I can hardly agree with him in believing that "their arithmetical coincidence with certain musical intervals is merely accidental, and such as might be expected, according to the law of probabilities, when so large a number of lines are concerned." His conclusion, however, was based upon observations of the more minute lines, to which I have already referred, as less satisfactory. I know of no law of probability which would explain such close approximations as are shown in Tables II., III. and IV., without supposing some kind of harmonical dependence upon one fundamental vibration.

The existence of analogous harmonies in atomicities, chemical composition, phyllotaxis, and planetary relations, suggests the hypothesis that the *vis inertiæ* itself may be determined by harmonic vibrations. The two forces which are commonly exclusively considered in explaining orbital revolution, are centripetal gravitation, and tangential inertia. There must, also, be a force of centrifugal emanation which enables the Sun to radiate his continual supply of light and heat, and I believe that a proper application of mathematical analysis in the investigation of such a force, would open a wide field for interesting and valuable research.

If the ultimate particles of bodies are mathematical points, the potential energies of cosmical globes are proportional to the products of their masses by their radii. The density of particles in elastic fluids varying as the squares of the times of molecular diffusion, let us suppose that the time of diffusion is determined by the ratio of orbital time, to time of fall to an attracting centre ($\sqrt{32}$). Then, if l represent the length of elastic undulation, we may have some reason to look for the following proportionality :

$$mr \propto \frac{1}{l} \propto vd \propto vt^2 \propto 32\, v.$$

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[*] Or, Fourth and Minor Third.

[†] Or, Fourth and Major Third.

[‡] Loc. cit. p. 100.

Let us assume the correctness of the following values :

Constant of aberration (Struve).....................	497.827
Theoretical velocity of sound (Enc. Metrop.)........	910.322
Mass, Earth ÷ Sun (Newton)......................	$4.432 \left(\frac{\text{parallax}}{1000}\right)^3$
Earth's radius (Norton)...........................	3962.8

The foregoing proportionality will then yield the following results :

Velocity (Light ÷ Sound) = $\frac{1}{32}\, C_{23} \div C_{-3} = 32^4 =$ $mr \div 32 =$	1,048,576
Velocity of Light (1,048,576 × 916.322 ÷ 5280)......	181,976
Distance of Sun (181,976 × 497.827).................	90,592,565
Parallax (1,296,000″ × 3962.8) ÷ (2π × 90,592,565)..	9″.0227
Mass, 4.432 (par ÷ 1000)^3..........................	1 ÷ 307,178
Mass × radius, (Sun ÷ Earth) = 32^5................	33,554,432
Radius (Sun ÷ Earth), 33,554,432 ÷ 307,178.........	109.23
Sun's semi-diameter, 9″.0227 × 109.23..............	985″.5

The most careful estimates of the Sun's actual semi-diameter vary between 961″.82 (Br. Naut. Almanac), and 962″.1025 (Lockyer), being about 2½ per cent. less than the above theoretical value. In consideration of the fact that no allowance has been made for orbital eccentricity, æthereal condensation, mean atmospheric elasticity, or other modifying influence, so close an approximation is very satisfactory. If the theoretical velocity of sound were increased ⅜ of one per cent. in consequence of such allowances, we should have : Sun's distance, 91,158,769 ; parallax, 8″.966 ; mass, 312,973 ; radius, 107.21 ; semi-diameter, 961″.25. The most recent astronomical estimates of solar distance range between 91,186,000 (Winnecke), and 92,380,000 (Newcomb).

In a former communication (*ante*, xii. 399), I assigned 91,965,500 miles as a theoretical upper limit of the Earth's possible mean distance from the Sun. For reasons which seem to me still more conclusive, I am inclined to regard the above approximation of 90,592,565 miles as the lowest possible limit, and I shall look with much interest and confident expectation, for a confirmation of these estimates by the observations of the approaching transit of Venus.

The inverse proportionality of velocity to wave-length suggests a further extension of the comparison. Airy's estimate of the time required for the solar disturbance of July 7th, 1872, to affect the terrestrial magnetism, would make the luminous velocity (2 *h*. 20 *m*. ÷ 497.827 *s*. =) 16.87 × the magnetic. This estimate would be increased if the outburst took place before it was observed by Father Secchi, but it is not to be supposed that it could be doubled. If the Sun's distance is 90,592,565 miles, the theoretical explosive range of hydrogen should be 4 (90,592,565 ÷ 307,198) = 1179.7 ; (3962.8 ÷ 1179.7) ÷ 294.92 = 17.4. This appears to indicate a magnetic gamut, four octaves below that of light, bearing the same relations to the luminous octave, in frequency of undulation, as a single vibration of a pendulum bears to the lowest number of vibrations which will produce a continuous musical note. If this ratio should be confirmed by further observations, it will furnish a valuable addition to the numerical magnetic relations which I have already pointed out (*ante*, x., 358, &c.).

A tendency to four-octave intervals, is shown in the different planetary values of *mr* (Sun ÷ planet) which are, approximately as follows:

Mercury............	$2^{30} \times x$*	Jupiter..............	$2^{13} \times \frac{5}{4}$ (E)
Venus...............	$2^{25} \times \frac{4}{3}$ (F)	Saturn..............	$2^{15} \times \frac{5}{4}$ (E)
Earth...............	2^{25} (C)	Uranus	$2^{19} \times \frac{6}{5}$ (D ♯)
Mars................	2^{29} (C)	Neptune	$2^{18} \times \frac{5}{3}$ (A)

The value for Mercury is 3 × 4 octaves higher than that for Neptune; Venus and Earth, 3 × 4 octaves higher than that of Jupiter; Mars, 4 octaves higher than Earth; Uranus, 4 octaves higher than Saturn.

Stated Meeting, March 7th, 1873.

Present 22 members.

Vice-President, Mr. **Fraley**, in the Chair.

A letter accepting membership was received from Geo. Burrows, M. D., F. R. S., Prest. R. College of Physicians, London, 18 Cavendish Square, February 12, 1873.

Letters acknowledging receipt of publications were read from the Society of Sciences at Geneva (XIV iii, 86, 87), Nov. 1, 1872; from the Society at Wiesbaden (78 to 87), Sept. 10, 1872; from the R. Bavarian Academy (86 to 87 bis; XIV. iii, bis), Dec. 1, 1872; Prof. R. Owen (84, 85), Dec. 1, 1871; and the Smithsonian Institute (89), Feb. 15, 1873.

Letters of envoy were received from the R. Bavarian Academy, asking also for Transactions (XII ii, iii.); from the R. Society London, and Linæan Society asking for Transactions (III, pp. 315 to 382), and Proceedings (62 and 87,); And from the S. P. S. Geneva.

On motion, the Librarian was authorized to forward the required publications if possible, and to request in return a copy of the Catalogue of Memoirs published by the Royal Society.

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* The mass of Mercury is so uncertain, that the note corresponding to the C line cannot be determined.

A letter from Mr. Hector Orr was read, describing a new and ingenious microscope-slide, devised and exhibited before the Franklin Institute by its Curator Mr. D. S. Holman, at a meeting of its Optical Section.

Donations for the Library were received from the Russian Geographical Society: Bavarian and Belgian Academies: the Societies at Wiesbaden, Frankfort and Geneva: Revue Politique and Dr. Girard, of Paris: the Meteorological Office, Society of Arts, and Prof. Owen, of London: the Naval Observatory of San Fernando: the Mass. Board of R. R. Commissioners; Ed. M. Stone, of Providence: American Journal of Science and Prof. Dana, of New Haven: the Phil. Journal of Pharmacy, Dr. Kirkbride and Prof. Cope: the Board of Public Charities of Pennsylvania; and the Bureau of Education at Washington.

The death of Dr. Hugh L. Hodge, of Philadelphia, Feb. 26th, aged 77, was announced by Prof. Cresson, and, on motion made, Dr. Penrose was appointed to prepare an obituary notice of the deceased.

The death of Dr. Thos. McEuen, of Philadelphia, Feb. 27th, aged 73, was announced by Prof. Cresson.

Dr. Seiler was invited to exhibit before the meeting two Magic Lantern Slides for producing on the screen the alternately vibrating waves of light, one of which he had made in imitation of the apparatus used for that purpose in his recent lectures by Prof. Tyndall, consisting of concentric ellipses on a revolving disc: the other he had devised and constructed as an easier and simpler form which any one could make, viz., a long slide on which diverging and converging lines replace the ellipses. A medial horizontal straight line gives a constant central point of light, to and from which vibrating points are produced by the diverging and converging straight lines above and below the medial line.

The Secretary exhibited a large Map of the Underground Workings of the Collieries south of Wilksbarre, in the Third Anthracite Coal Basin of Pennsylvania, surveyed and drawn by Mr. Henry Harden, C. E., and described the geological features of that part of the basin portrayed by the map.

Mr. Lesley also described the geological facts of most interest recently studied by Mr. Franklin Platt and Mr. John H. Harden, C. E., on Dunning's Creek, Bedford County, Pennsylvania, and compared the exhibition of the Fossil Ore beds of No. V (Clinton Group, Upper Silurian) with that of the same deposit at Frankstown, Danville and other points in Pennsylvania.

Mr. Price introduced the subject of a Geological Survey of Pennsylvania, which led to its discussion by Prof. Trego and other members present.

Prof. Chase placed on record, with explanatory remarks, four notes: 1, on Planeto-taxis; 2, on the rotation of the Sun and interasteroidal planets; 3, on the special planetary relations to the Sun-spot period; 4, on the relative velocity of light and gravity.

Pending nominations Nos. 715 to 728, and new nominations Nos. 729 to 732, were read.

And the meeting was adjourned.

ST. CLAIRSVILLE AND BEDFORD RAILROAD; AND DUNNING'S CREEK FOSSIL IRON ORE.

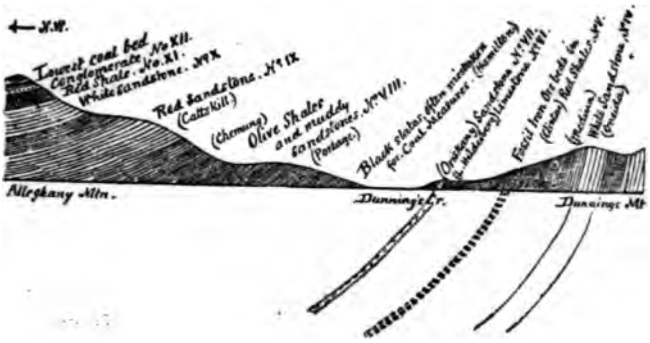
By Professor J. P. Lesley.

(*Read before the American Philosophical Society, March 7, 1873.*)

Mr. Franklin Platt has recently made for me a topographical and geological survey and sketch-map of some valuable deposits of iron ore in Bedford county, Pennsylvania; and Mr. John W. Harden a special study of the same with a view to the best way and probable expense of mining the ores. I have had the map ithographed, as an illustration of the characteristic features of the outcrop of the Upper Silurian rocks, which borders on the east the Bituminous Coal Field of Western Pennsylvania

In front of the Allegheny Mountains, which runs for a hundred miles in nearly a straight (N. E. and S. W.) line from Muncy to opposite Bedford, lies a long, narrow, straight, deep valley, about five miles wide, occupied successively by the West Branch Susquehanna, the Bald Eagle Creek, the Little Juniata, the south head of the Juniata river, and finally by Dunning's Creek, which flows southwest and joins the Raystown Juniata at Bedford.

A geological cross-section of this valley, taken almost anywhere, is something like this:—Fig. 1.



The only notable variations from the above cross-section occur at three far distant points: 1. At Muncy, where the fossil ore flattens and sweeps round the northeast anticlinal end of the Bald Eagle Mountain; 2. at Frankstown and Holidaysburg, where the fossil ore flattens and sweeps round the southwest end of Bald Eagle Mountain and the northeast end of Dunning's Mountain; 3. North of Bedford; where in a precisely similar style, the fossil ore beds, the red shales in which they lie embeded, the limestone formation (VI) over the red shale (V), and the Oriskany sandstone (VII) all flatten and sweep in concentric semi-circles round the southwest end of Dunning's Mountain, a ridge of rock extending from Holidaysburg to St. Clairsville, about 20 miles. This mountain opposite St. Clairsville makes a right angle and runs east several miles, and then makes another right angle, and resumes its south-southwest course, past Bedford, into Maryland.

The fossil ore beds follow its flank.

Where the mountain runs its regular course the fossil ore beds are steep (nearly vertical) and their outcrops lie high up on the mountain side.

But where the mountain makes its offset to the eastward the fossil ore beds (and other formations) lie flat, dip south at gentle angles, and their outcrops are far removed from the base of the mountain.

The region specially examined in this case sweeps round with the ore beds; having them steep on the mountain side at its north and northwest end—having them flat and away from the mountain (on Black Oak Ridge) in its middle portion—and having them again steep and up the mountain side, at its eastern and southern end. Geographically, it begins at St. Clairsville (its northwest end); extends three miles southward along the east slope of Black Oak Ridge; then half a mile eastward; and then three miles northeastward into Dutch corner. Its St. Clairsville end is ten miles from Bedford; its Dutch Corner or southeast end seven miles.

The surveyed line of the Bedford and Dunning's Creek Railroad passes close to its southern boundary; and by this branch of the Huntingdon and Bedford line, its railroad distance from Huntingdon would be 57, and from Philadelphia 259 miles.

Should the B. & D. C. R. R. pass St. Clairsville and reach McKee's Gap (through Dunning's Mountain into Morrison's Cove) 17 miles north of St. Clairsville, the outlet of the ore would be, via Altoona, to Pittsburgh also.

I. OUTCROPS OF FOSSIL ORE.—Three cross-sections, marked AB, AC, AD, on the map, show the geological structure along lines diverging west southwest and south, and the steepness or flatness of the ore beds.

Figs. 2, 3, 4. Representing these sections are reduced to a scale of 2 miles to the inch, in photolithographing them.

Fig. 2.

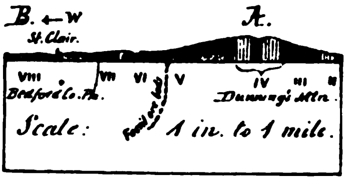


Fig. 3

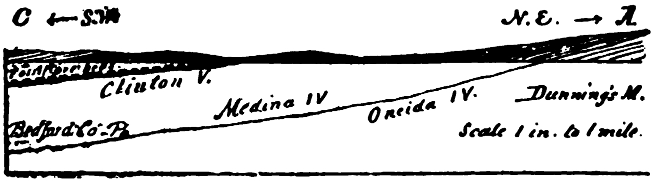
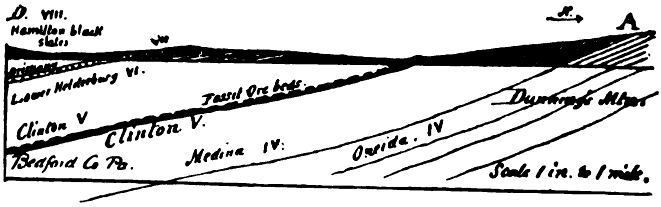


Fig. 4.



AB, Fig. 2, 8,000 feet long, passes through St. Clairsville and a gap in Black Oak Ridge, and shows the formations IV, V, VI, VII, and black slates of VIII, all in a vertical posture.

AC, Fig. 3, 15,000 feet long, shows the formations IV, V, VI, and VII flattened down, so as to spread the ore over the surface of the hill.

AD, Fig 4, 15,000 feet long, shows the same formations, with the ore dipping at an angle of about 20°.

There is a small sharply-pinched synclinal (trough) of limestone VI, between Black Oak Ridge and the foot of the mountain south of St. Clairsville. This Upper Silurian limestone basin is less than 150 yards across.

Black Oak Ridge is about 200 feet high above the brook at its foot. At its north end near St. Clairsville the Oriskany Sandstone VII forms its backbone; the black slates of VIII are there so much like coal-measure slates that the villagers of St. Clair explore them for coal beds; which of course do not exist. They are near the base of the Devonian.

At Weiset's house and southward the outcrop of the ore is at the bottom, or on the east slope of Black Oak Ridge. See local section, Fig. 5.

Figs. 5 and 6. Reduced to a scale of 200 yards to one inch.

Fig. 5.

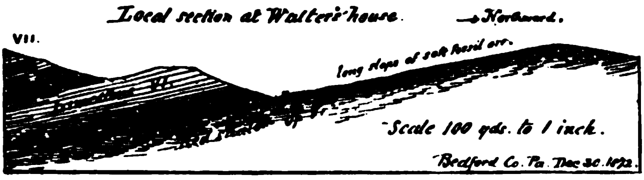
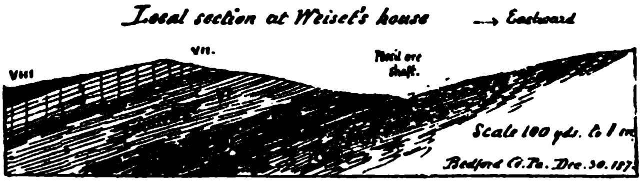

Local section at Walter's house.
→ Northward.
VII.
VI.
long slope of soft fossil ore.
Scale 100 yds. to 1 inch.
Bedford Co. Pa. Dec 30. 1872.

Fig. 6.



From Griffith's house eastward, the ontcrop ore is on the summit of the ridge, and the bed spreads broadly down its gently-sloping back. See local section, Fig. 6.

From Walter's house, northeastward, the outcrop slips down the north or front slope of the hill, facing the mountain, the hill top being about 150 feet above the brook.

The Limestone Ridge (capped with sandstone) runs round south of the ore ridge, and is twice as high (300 feet).

As the sections are drawn to scale (horizontal and vertical the same) they explain themselves, and proceed to the description of the ore beds themselves.

II. The Fossil Ore Beds.—There are three ore beds in the red shale of V. They lie so close together that they can be quarried together where the dip is gentle, as at Walter's. But they lie so far apart that they cannot always be mined by one gangway where the dip is vertical or very steep.

The most northern openings in this range are 150 yards south of

Weiset's house, and just above the brook level. Three shafts on the three beds. Upper and middle fallen in. Lower bed 12 inches of ore. Slates in roof and floor. Dip of ore N. 55° W. 30° to 35°. General dip of formation 20°+. All three beds in 12 feet of shales.

Ore crop on the hill top 600 yards east of Griffith's, dipping gently S.W. say 6°. Ore crop on hill top, 400 yards E. 20° north of Sill's house; dip say 6°. Ore crop on road at foot of the hill, near the creek, 350 yards E. of Sill's house; dip say 5°. Shaft on hill top, midway between Sill's and Walter's, shows 41 inches of fossil ore in 12 feet of measures; dip say 5° to the south. See local section, Fig, 7.

FIG VII

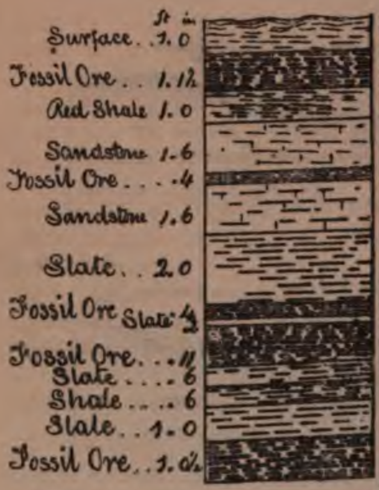


FIG 8

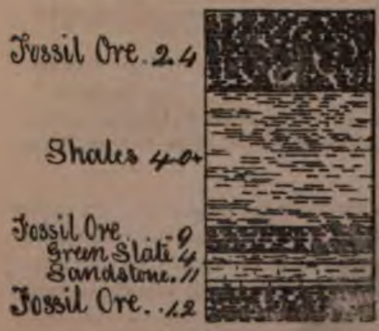


FIG 9

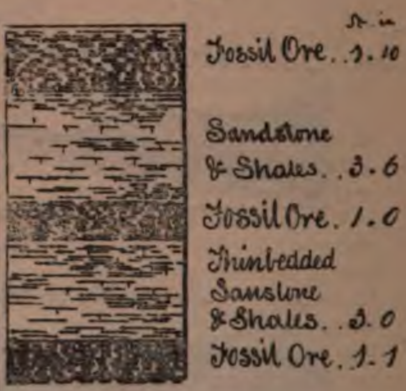
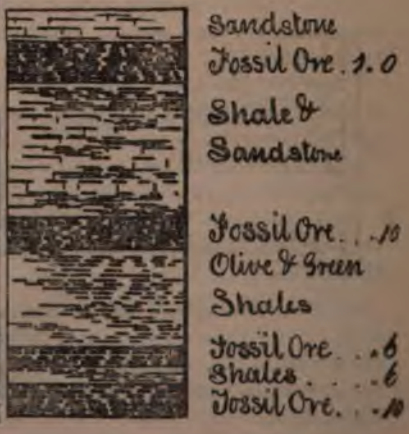


FIG 10



On Walter's place near the brook, this lowest bed has been mined for the furnace, 15 inches thick; very fine ore.

The heaviest covering Mr. Walter has found lying upon the upper bed of ore, anywhere on the slope from brook to hill top between his farm and Griffith's, is 6 feet of olive slates. This is at the top of the hill up from the last named mining ground.

North of Walter's house, on the road, the above section gives 47 inches of ore, in 10 feet of space; dip say 4° S. 70° East. See vertical section, Fig. 8.

About 900 yards east of the road, and on the north side of the ridge, a shaft on the outcrop shows 47 inches of ore in 10½ feet of measures; dip say 8° S. 50° East. Fig. 9.

About 500 yards east of the last exposure, and also on the north slope of the ridge, 80 feet below its crest, the ore dips S. 30° E. 7° to 8°. Here the ore crop leaves the ridge and strikes across to the mountain side.

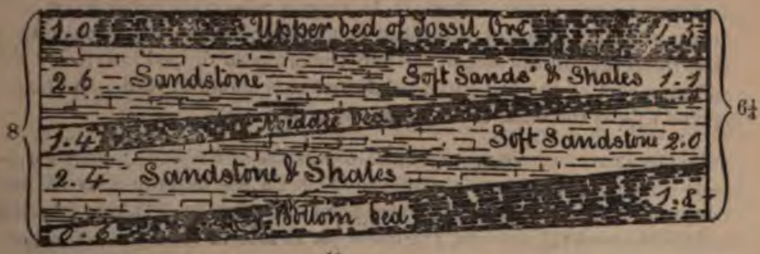
At the northeast end of Dutch Corner the next section shows 38 inches of ore in 10½ feet of measures; dip of sandstone S. 30° W. 17°. Fig. 10.

The thickness of ore in each bed varies with every rod of outcrop, as may be seen from the above vertical sections.

The total thickness of ore in all three beds, on the contrary, scarcely varies at all. In other words, one can confidently count on a total thickness of between three and four feet of the ore in from ten to twelve feet of measures. Secondly, on always having at least one of the three beds of a good size. Thirdly, on always mining two of the beds in one gangway. One is always secure of at least two feet of good fossil ore, no matter where the beds are opened.

This regularity conjoined with irregularity is well illustrated in one of the two gangways of the Kemble Iron Company in the gap at Bedford. It inspires great confidence in the mining qualities of the formation all along Dunning's Mountain for twenty miles. The two connected sections,

FIG. 11



Kemble Iron Co Bedford Pa.

Fig. 11, were got in the north gangway, one at 400 yards in, and the other at 475 yards.

III. QUALITY OF ORE.—The three beds seem to preserve their three individually distinct and different characters.

The top bed is a hard fossiliferous ore.

The middle bed is hard, and almost a limestone.

The bottom bed is soft, rich in iron, and holds but little lime. It looks (theoretically) as if it had always been the water-bearing stratum, and has suffered therefore so complete a washing out that all its original shells have disappeared, and their places and forms been assumed by the oxide of iron. This, however, will be its state only to a certain depth below the present valley bottoms. It will then become a rocky calcareous ore, something like the middle bed. The same is true of it (and the other beds to a less extent) when mined down from the outcrop. They will lose in iron and gain in lime.

At Bloomsburg "soft ore" holding 85 per cent. perox. iron and only a trace of carbonate of lime, turns into "hard ore" holding 61 per cent. perox. iron and 33 per cent. carbonate of lime.

At Hopewell furnace "soft ore" of 78 per cent. perox. iron and a trace of carbonate of lime, becomes a "hard ore" of 55 per cent. perox. iron and 31 per cent. carbonate of lime.

A multitude of analyses show the soft ore to range in its peroxide of iron between 30 and 75 per cent. Where the dip is steep the breast of soft ore is of course short; where the dip is flat the breast of soft ore is very extensive—as between Griffith's and Walter's, and so on into Dutch Corner. Where the bed spreads as a surface-coating to a broad and gentle hillslope it is in its highest prime condition, both of richness and for cheap and abundant mining. It is here about a 50 per cent. ore; that is, it will allow of getting one ton of iron from two tons of ore, or practically two tons and a quarter. Prof. H. D. Rogers, who made a careful, special study of this important subject at Danville and Bloomsburg, concluded that when the hillside sloped 15° and the ore beds dipped into it 30° the softened part of the bed extended downwards about 40 yards, and he assumed this as the basis of his calculations of quality.

IV. QUANTITY OF ORE.—*From St. Clairsville to Griffith's; steep dip.*—

(a.) From opposite St. Clairsville to Weiset's the outcrop descends the mountain slope 3,200 yards to water level in the brook. Taking 40 yards as the depth of the soft ore, thickness (in 12 feet of measures) 40 inches (1 1-9 yard) of ore, and 2 tons to the cubic yard, we have 280,000 tons of soft ore; say one-half of this lies above brook water level.

(b.) *From Weiset's to Griffith's; dip growing less steep.*—Outcrop always from 25 to 35 feet above brook level, on east side of Black Oak Ridge, 1,900 yards. Soft ore say 50 yards down; tons 210,000; mostly below brook water level.

(c.) *From Griffith's to* [illegible] *300 yards east of road north of Walter's;*

dip almost horizontal.—Top ore bed scarcely 3 or 4 feet under surface anywhere; ore beds thoroughly softened and enriched by dissolution of the shells; lowest bed very rich; distance 1,500 yards; breadth from brook up to hilltop 200 yards; total amount of soft ore above brook to be got by stripping, 400,000 tons; total of ore to be got by stripping or otherwise, 660,000 tons.

Note.—The deduction 660,000 to 400,000 is based on the fact that towards the bottom of the slope the covering shales get to be 10 or 12 feet thick (as in the old celler opposite Walter's house), and may be equally thick in other places. This will interfere only with the open quarry work, but not with underground mining.

(*d.*) South of the brook the beds descend beneath the country very flat and are softened doubtless to a great distance downward. If we assume 300 yards, we have thus, beneath water level, one million (1,000,000) tons of soft ore.

(*e.*) *From Walter's eastward.*—For the first 1,300 yards north eastward. At 800 yards the crop has got down 25 feet below the crest of the ridge on its north face; at 1,300 yards 100 feet. Most of the distance, the covering rocks allow the complete sofening of the beds. Mining from the brook by a short tunnel (northward). Breast of say 200 yards. Total of soft ore, 580,000 tons.

Below brook water level (in the other direction, southwards and downwards) another 580,000 tons of soft ore, or even a larger quantity, is available.

(*f.*) Along the crop, in the curving valley bottom of the (northern) brook (north of the ridge and against the mountain), 2,800 yards to the end of Dutch Corner. Ore all below water level. Dip steep towards the east end. Extent of softening say 40 yards down. Total of soft ore, 250,000 tons.

Soft ore above water level, one million one hundred and twenty thousand tons...1,120,000

Soft ore below level, one million six hundred thousand tons....1,600,000

Soft ore parts of the bed only..........................2,720,000

It is unnecessary to calculate the quantities of harder ore in the undecomposed parts of the beds, amounting to millions of tons, for these will remain as a reserve for the future. The regularity of this ore formation enables one to assert that there lie six million (6,000,000) tons of ore, more or less, under every square mile of the district, where the dip is gentle.

No account is here taken of the ten miles of vertical beds from Dutch Corner to Bedford, and the vertical run of the beds for some miles north of St. Clairsville along the west side of Dunning's Mountain, towards Sarah Furnace, on the way to McKee's Gap.

A railway line up Dunning's Creek from Bedford to Holidaysburg (or McKee's Gap) will bring into play this long outcrop (north of St. Clairsville), and there can be little doubt that mining operations will be successful at certain points along the outcrop.

It is well to remember the ore bed at the bottom of the red shale formation of No. V, the outcrop of which ought to be found still higher up the slope of Dunning Mountain, close to the uppermost stratum of the Middle Silurian White Sandrock of No. IV. Between Marklesburg and Saxton this bed (part rock ore and part soft fossil) is more than 20 feet thick, and is mined, yielding from 2 to 6 feet of soft ore.

METHOD OF MINING.—Mr. Harden describes his views of the locality thus: In the several sections of the measures taken at the various openings and points of exposure we have conditions exceptionably favorable to the working of the less inclined portions of the belt, by open quarrying, and a personal examination made of the two tunnel openings of the Kemble Iron Company at Bedford Gap discovered nothing to me likely to conduce to an unfavorable condition for the mining of the more highly inclined and heavier covered portions of it. On the contrary, a somewhat extended practice in the mining of such like measures leads me to the conclusion, that, in the exercise of the skill necessary to all such work, the mining of these ores will not be productive of more than the average of ordinary difficulty, and as compared with the mining of the unstratified ores, will certainly be less, the cost of production also bearing relation thereto; always providing that the ores maintain their aggregate thickness and their average distance one from the other. And since the sections exhibited were taken at points extending ever an area of several miles, we are not led to expect a greater variableness than represent the sections themselves.

Hand specimens of the ore brought away gave a specific gravity of 2,818, a little more than that of the sandstone by which it is accompanied. This gives 175.62 lbs, per cube foot or 12.75 cubic feet to the ton.

From these data the production of ore will be 284 tons per inch per acre; which multiply by the number of inches thick in any given section and we have the total in tons per acre of the locality to which the section applies. Average the whole, say at 36 inches, and we get 10,224 tons per acre over the area covered.

Presuming that those localities hold the beds easiest gotten will be the first to be attacked, a word on open quarrying will not be out of place. Stripping the ore, that is, taking off the surface covering, will necessarily be the first operation, and in doing this the dirt should not be dumped where it is likely to be in the way of future operations. This is not a needless warning. There is not an opening with which I am acquainted, unless lately made, that is not suffering more or less by being hampered up with old stripping, and where, in more than one instance, it has not had to be moved a second time.

Mr. Walters says that the greatest depth of covering on his farm, and at the explorations made in the neighborhood of it, is 6 feet to the top

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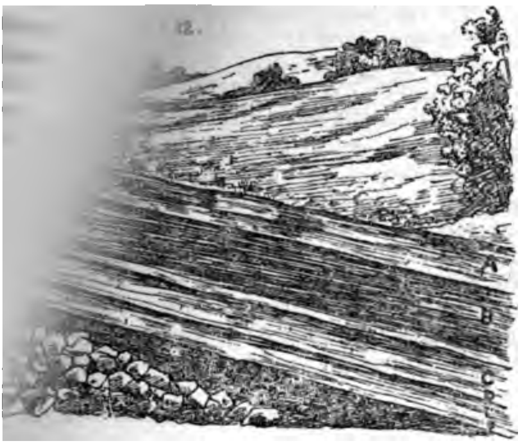
taken on Walter's farm and
help to convey the intention.



K-FACE WITH THE STRIPPING OFF TO THE FIRST BAND OF ORE.

ıpping, 6 feet thick.
f Top Band Ore, 11 feet width of strip, 24 inches thick.
of Shales and Sandstone, 42 inches.
Band of Ore, 12 inches.
·d of Shales and Sandstones, 36 inches.
·m Band of Ore, 13 inches.
of Ore face with 2 intervals, 10 feet 7 inches, include Stripping,
. inches.

·s the ore to be taken out constitutes in bulk only a fourth of that
quarried, and as when loose the refuse will occupy one and a half

times the space it did in the solid, it follows that the refuse heap will increase beyond the limits of the area quarried; this, however, is provided for in the rise of the hill as the work advances. Retaining walls will also be needed, from which to dump the ore into the railroad cars; these will be made of posts and planks backed up with the refuse.

The lay of the measures as a whole and their individual structure are each of a character favorable to such a mode of procedure. The jointed condition of the sandstone, when not in thin plates, will allow the free use of the crow-bar to advantage, but the shales operated on from above, that is, perpendicular to their bedding, will be tough to the pick-axe; holed under, or worked at on the face will give the best result.

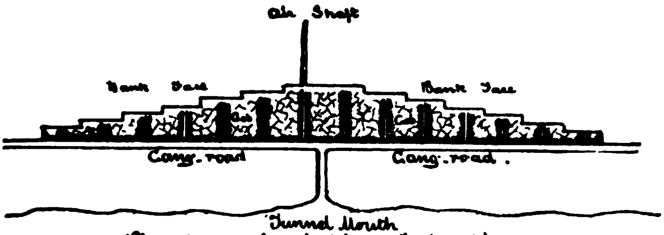
While it may not be absolutely necessary to resort to blasting, a judicious use of gunpowder will be of great advantage. A series of holes put down to the bottom of the ore, or to the bottom of the lower interval, at a foot from face of stripping, and loaded so as to loosen the mass only, would make easier work for the crow-bar and pick-axe, and would not make the ore any the less easy of separation from the refuse. Each quarryman has generally his own notion of the quantity of powder to be used in a given case, seldom deduced from any fixed data. Practice has shown that the quantity must be increased as the cube of the mass to be blasted; from which it is laid down that the cube of the line of least resistance in feet, divided by two, equals the necessary quantity in ounces; less, however, will answer the purpose here; well directed experiment at the beginning will guide the application of the rule.

In estimating the cost of quarrying these ore beds, we have tolerably well-defined data in the ores and intervening strata, but a fluctuating element in the amount of covering. Taking, however, as an example the section before given, I am of opinion that at the present rate of wages, the ore may be put into cars on the quarry for—in other words, that the cost of production will be—one dollar twenty-five cents per ton ($1.25). With a less thickness of ore or increased covering the cost of production will be increased; 38 inches of ore, the average estimated, with the same amount of covering, will cost one dollar fifty-four cents ($1.54).

In the more highly inclined and heavier covered beds, we have conditions which render mining necessary, and the method I would adopt would be that which, in coal and the clay ironstone bands, is called Longwall; for whether mined in shorter or longer "banks," called by some "stoops," the same principle prevails, namely, that of mining out the whole of the mineral, packing the refuse gob or goaf, in the space mined, and putting out the ore either by shoots or cars, agreeable to the angle of inclination at which the measures lie.

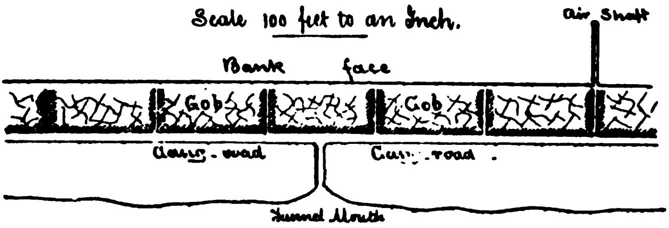
With such inclinations as wherein cars cannot be made use of in the gob roads, a drift or tunnel will be put in above water-level and along the strike of the ore of sufficient capacity for the running of cars, say 7 feet wide at the floor, battering inward to 5 feet at the roof, and 6 feet or 6 feet 6 inches high, regulated by the height of the cars used; a shoot by which to deliver the ore into them to be provided. This gang road should have a series of "bolt holes" (places of refuge) cut for men to escape into when meeting the cars, and it will be necessary to well timber this road, the dimensions given being those clear of the timbers. On the rise side an opening head will be made parallel and immediately contiguous to it, both being extended just so far as it is intended to work the ore, it may be 1,000 or any number of feet regulated by the nature and the local uniformity of the measures, and the limit of economy in haulage and ventilation. The mouth of the gang road may either be at one end of the work, or it may be in the centre of it, receiving cars from right and left.

The opening head, as it is driven, will be divided into "banks" of say 35 or 40 feet long on the face, which banks will be mined to the rise, the ore being put down a road left in the centre by the gob being built up on either side, and supporting the roof, as shown in the diagram below. Ventilation being provided for by staples (small shafts) being sunk from the surface, or by drifts put up in the ore; when that does not crop out on the surface, both will be needed.



Plan for working the highly inclined beds

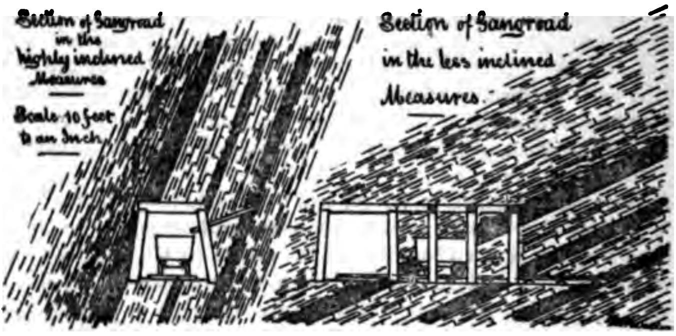
Scale 100 feet to an Inch.



With dips of less inclination, wider banks may be worked, the ore being run to the gang road by self-acting inclines.

While it is not easy to define beforehand with preciseness, what will be the action of any group of strata, the foregoing is a general description of the methods I believe best to be adopted in the mining of these ores. Of necessity contingencies will present themselves, which can only be dealt with as they arise, but in the hands of a skillful and careful manager, I know of nothing likely to lead to unfavorable results, and I am of opinion that, the ores, maintaining their thickness, will be mined and put into railroad cars at the mouth of the mine for two dollars and twenty-five cents ($2.25) per ton.

Plan for working the less inclined beds.


Section of Gangroad in the highly inclined Measures
Scale 10 feet to an Inch
Section of Gangroad in the less inclined Measures.

Stated Meeting, March 21st, 1873.

Present, 18 members.

Vice-President, Mr. **Fraley**, in the Chair.

Letters were received from the Linnean Society, dated London (Burlington House, Piccadilly), August 15th, 1872, acknowledging the receipt of Transactions A. P. S. XIV, i, iii (requesting ii), and Proceedings 83 to 87, also transmitting publications of that Society, and from the Boston Public Library, acknowledging the receipt of No. 89.

A letter was read from W. A. Mansell & Co., 2 Percy Street, Rathbone Place, W. London, February 25th 1873, requesting the Society to purchase a copy of the Series of Photographs of the British Museum.

Donations for the Library were announced from the R. Prussian Academy, Mr. Robert Grassmann, of Stettin, the

French Geographical Society and Revue Politique, the Royal and R. Astronomical and Linnean Society, Meteorological Office, the Royal Observatory at the Cape of Good Hope, London Nature, the Essex Institute, American Chemist, Penn Monthly, Franklin Institute, Medical News, Pennsylvania Institution for the Deaf and Dumb, Prof. Dr. Rand, Mr. W. E. Dubois, the P. Episcopal Hospital in Philadelphia, and Mansell & Co., of London.

An obituary notice of Dr. C. D. Meigs, prepared by appointment of the Society by Dr. John Bell before his death, was read by the Secretary of the evening.

The decease of Prof. John Torrey, of Columbia College, New York, on the 16th inst., aged 75, was announced.

Prof. P. E. Chase communicated a note on the Gamuts of Sound and Light. (See page 149 ante.)

Mr. Holman, by request, exhibited the working of his new Microscope-slide, for observing at leisure, and through long intervals of time, blood corpuscles, amœbæ, and other floating objects.

Prof. Frazer described a convenient and cheap device for giving any required altitude or slope to a limelight lanthorn, by means of a common table, with castors on two legs only, and with three superposed tops, hinged so as to open like the letter Z.

Pending nominations 715 to 732, and new nominations Nos. 733, 734, 735 were read.

On motion of Mr. Price, seconded by General Stokes, it was resolved that this Society recommend to the Legislature the passage of a law providing for a new and comprehensive Geological Survey of the State.

The Vice-President informed the meeting that the securities of the Society are lodged in the vaults of the Schuylkill Navigation Co., and on motion, the Treasurer was authorized to rent a box in some one of the offices of safe deposit, for their better security.

And the meeting was adjourned.

OBITUARY NOTICE OF CHARLES D. MEIGS, M. D.

By John Bell, M. D.

(*Read before the American Philosophical Society, March 21st,* 1873.)

In preparing an obituary memoir of our deceased associate, Dr. Charles D. Meigs, the writer must wish for the talent of a practised limner who would give the portraiture of a man of pure morals, kind and gentle, and deferentially polite, in an age of assertion, adorning and ennobling his profession by his writings and prelections, his skill and tact in devising, and opportune the in application of the means for relief and cure of sickness and suffering at all hours, and at the sacrifice of his personal comfort and domestic and social pleasures.

Doctor Meigs was born February 19th, 1792, in the Island of Bermuda, where his parents had taken up their temporary abode, but in a few months after they returned to their native home in New Haven, Connecticut. At the age of seven years he accompanied his father to Athens, Georgia, on the occasion of the latter being made President of the College at that place. Under such favoring auspices the education of young Charles was carried on with the happiest results, as manifested by his knowledge of the Greek and Latin classics, in addition to that in other branches. He acquired, through an intimate intercourse with a French emigrant noble, a command of that language, so that he was able to speak and write it with great fluency and idiomatic accuracy. During a portion of his boyhood his delicate frame and health gained strength and restoration by following the advice of his physician, that he should go for a season into the Cherokee country and participate to a certain extent in Indian life. Here he found in the person of one of the natives a companion and teacher in riding and shooting, whose extempore lessons were probably more effective for the purposes intended than formal instruction in the ménage or cavalry drill. It was Chiron teaching the future follower of Esculapius. He graduated at the University of Georgia in 1809. In the same year, 1809, Dr. Meigs began his medical studies under the instructions of Dr. Fendall (supposed in Augusta, Georgia,) to whom he was apprenticed for three years and took his degree of the Doctorate in the University of Pennsylvania, in the year 1815. His next step in life, to him in every way a fortunate one, was his marriage with Miss Mary Montgomery, of Philadelphia. From this union came a numerous issue, all of the members of which were estimable, some distinguished members of society. Much as may be accorded in this case to a father's good example, still more was due to the affectionate care and judicious guidance of the mother who in the discharge of her home duties cared not for the glitter of fashion and found ample space for the exercise of her true privileges without bustling in the crowd and joining in angry discussions on woman's rights.

The field chosen by Dr. Meigs for professional labor was Augusta, Georgia, and the selection was followed by every prospect of success, but the ill-health of Mrs. Meigs made him abandon his expectations and remove to Philadelphia. Through the temporary cloud of disappointment at his being obliged to change the theatre of action, even his sanguine nature would hardly prompt him at the moment to indulge in visions of professional fame and honors, which lay before him in a somewhat lengthened prospective. He had, like most of those most distinguished in the annals of medicine, to undergo a period of probation, in which patients were the persons who in smallest number came under his notice. But, whilst waiting for business, he was neither an idle nor a querulous expectant, nor a lounger watching for something to turn up, nor worse still, becoming a devotee of Bacchus and turning his back on the tutelary Apollo. He read and studied, and as a kind of literary exercise he began to compose a work of fiction, but never got further than the opening scenes. He would have preferred engaging in a translation of Haller's Elementa Physiologiæ, if he could have received encouragement from a publisher; but medical books of home production, either original or translated, were at that time few in number.

In this early period of his life, Dr. Meigs took an active part in the discussions in the Philadelphia Medical Society, in participation with others of his compeers, who afterwards gained for themselves a name as writers and teachers.

Among the early printed productions of his was the annual discourse before the Society, delivered February 18th, 1829.

He was one of the first to join in the formation of the Kappa Lambda Society, founded by Dr. Samuel Brown of Kentucky, in one of his annual visits to Philadelphia, the only defect of which was its being for some time a secret one. Its objects were the elevation of the medical profession, increase of its usefulness, and the promotion of harmony and good fellowship amongst its members. With this view it framed a code of ethics and brought out in 1825 a quarterly periodical called the North American Medical and Surgical Journal. It was the good fortune of the present writer as chairman of a committee on the projected Journal to be instrumental in having Dr. Meigs appointed one of its five editors; his associates in the work were, Drs. Bache, Coates, Hodge, La Roche, to whom were added at a subsequent period, Drs. Wood, Condie, and Bell. To the pages of the North American Medical and Surgical Journal, which soon met with the favor of the profession, both at home and abroad, the subject of our memoir contributed his share in the shape of original articles, reviews and a portion of the Quarterly Summary. His department in this last was Midwifery,—an attribution which showed a great change in his own views and action respecting this important branch of Medicine. In the first period of his career he carefully kept himself aloof from practising it, with an aversion scarcely less decided than that expressed by Lord Brougham against law, when it was a question with him whether to take it up as a profession, engage in the exclusive exercise or enter into public life. Writing from Edinburgh, Brougham says, that he still continues to detest his cursedest of all cursed professions; and some years later when in the Middle Temple, he tells Lord Gray, that there are few things so hateful as this profession; but notwithstanding this extreme repugnance, he became a member of the English Bar, went on the Northern Circuit, and concluded his legal career by being made Lord Chancellor.

Doctor Meigs was induced to change his course by the advice of judicious friends, who pointed out to him the advanced age of the prominent practitioners of Midwifery and the room that would ere long be left for younger aspirants. Accordingly he entered at once with his characteristic ardor the untried road, and soon began to win reputation for his assiduous attention and the skillful management of his patients, who were warm in their praises of their new accoucheur. With a knowledge of his great sensibility and imaginative turn of mind, one can readily understand the effort it must have cost him to subject himself to the trials of patience, under the wearisome details, the anxiety and responsibility which he continually encountered, in a still greater degree than in the ordinary practice of medicine, which of itself has a heavy load of cares to carry. The explanation must be found in the very qualities of the man, which made him regardless of difficulties and obstructions in the excited determination to overcome them, in the lofty belief that he had become a ministering spirit endowed with the almost apostolic powers for the relief of those who placed themselves under his care, and appealed to him in their trouble.

Once engaged in his mission, he gave himself no pause nor halted on the way, but steadily, cheerfully and kindly, at all hours and seasons, placed himself at the command of those who sought his services. If these were not always remembered with gratitude he did not complain, but consoled himself with the overflowing thankfulness and warm regard of those, and the number was continually increasing, who had been soothed and relieved by his ministrations.

Once fully engaged in the practice of Obstetrics he determined to make himself master of its literature, and with this view he set himself to a translation of Velpeau's Treatise on Midwifery, and projected an elementary work of his own on the same subject. Reference to a Medical Journal, edited at the time by the present writer, exhibits his opinion of this work in the following terms:

"The author writes in a style of blended aphorism and narrative, the first succinct and modestly laid down, the second clear and untrameled by extraneous matters. We feel as if we were conversing with one who had read much, practised much and meditated well on the various important questions embraced in his favorite branch of medical science, and who, whilst giving his own experience, is not desirous to dogmatize his own doctrine nor needlessly disparage those of others. If here and there a phrase somewhat figurative is met with, the reader will see that it does not mislead him as to the meaning: and he ought also to be informed that the author, so far from aiming at false effect by this means, deserves credit for his successfully keeping under wholesome restraint an active imagination, if not a temperament somewhat poetical. There is just evidence enough of these latter in an agreeable coloring of the style and turn of thought, without false analogies or exuberant phraseology."

The former appeared in 1831, and the latter (entitled "The Philadelphia Practice of Midwifery") in 1838.

At an earlier date, and while still an editor of the Medical Journal, he had brought out a translation of Hufeland on Scrofula, in 1829, and in the same year the annual discourse before the Philadelphia Medical Society. As we find him at this time, so he continued in the whole of his subsequent professional career, snatching at every interval left in his attendance on his patients to continue his studious life. Often would he, returning to his home from a detention through the greater part of the night in a sick-room, sit down to his desk and cheat himself of the few remaining hours till morning, in place of gladly taking the needed repose. This strain on mind and body carried with it the risk of a break down of both, and ambition's honors being lost when they are almost within grasp. Dr. Meigs in his reasoning process paid a heavy penalty for a neglect of the laws of nature in much severe suffering from an abdominal neuralgia, and also from a bronchial attack; but he rallied, regained his elastic bearing and customary strength, and resumed his onward course radiant and rejoicing to carry his sunshine of reviving spirit and skill into a long succession of sick-rooms.

On the breaking out of the Asiatic epidemic cholera in Philadelphia, in the summer of 1832, there was a call made for the services of a number of her physicians to help to stay the pestilence and mitigate its violence. On such occasions medical men are always eager volunteers to encounter the assaulting fiend, in disregard of their ease and health, and ready to make the forlorn hope, and sacrifice their lives for the public good and safety.

No blast of trumpet, no beat of drum heralded the advance of the physician to the conflict; and no honors are awarded to his success, no commemorative monument raised to his memory if he falls a sacrifice to his duty. Within the short period of six months during which the yellow fever of 1793 raged with the greatest violence in Philadelphia, no less than ten physicians were carried off by the disease and scarcely one of the surviving members of the faculty escaped an attack.

In the famine year of 1847, in Ireland, one hundred and seventy-eight Irish practitioners, exclusive of medical students and army surgeons, died of the prevailing typhus fever, being a proportion of nearly seven per cent. of the entire medical professional force of the country. The popular belief is that physicians have a kind of charmed life which gives them an immunity from the common causes of disease, and it is a matter of wonder that they bear up so well as they do under the various circumstances in which they are so continually placed.

Dr. Meigs was chosen to take charge of one of several temporary hospitals opened and fitted up by the city for the reception and treatment of patients who had no home nor the means of procuring suitable diet and nursing. In acknowledgment of their services, which happily were of short duration and unattended by mortality in their number, he, in common with each of his associates, received from the City Councils a silver pitcher.

A vacancy in the chair of Midwifery in the University of Pennsylvania, was created by the broken health and subsequent resignation of Dr. Dewees; and Dr. Meigs presented himself as a candidate for the succession. The contest between him and his successful rival, Dr. Hugh L. Hodge, was animated and served to extend a knowledge of his professional and personal merits. His disappointment on the occasion was keen, but was soon compensated for by his receiving with, we believe, entire unanimity on the part of the Trustees of the institution, the Professorship of Midwifery in the Jefferson Medical College in 1841. Three other chairs, viz.: of the Practice of Medicine, Chemistry, and Surgery, were filled at the same time by the election of Drs. John K. Mitchell, Franklin Bache, and Thomas D. Mutter; the other Professors were Drs. Joseph Pancoast, Robert M. Huston, and Robley Dunglison. Under this re-organization of the Faculty, the fortunes of the Jefferson College, which in former years had been often clouded and adverse, became at once propitious and successful, and to this happy result it must be said with a full appreciation of the ability and attainments of his associates in the College, Dr. Meigs largely contributed. With his professional treasury full to overflowing, earnest in inculcation, fluent in speech, easy and familiar, often approaching to colloquy in delivery he made his youthful auditory feel that they were addressed by a wise, experienced and affectionate parent whose lessons, whether of encouragement or warning amid the trials of the sick-room, were at once their belief and deeply impressed on their memory, to serve for their future guidance. Some shading to this picture is found in affluence of speech, which was sometimes redundant, and a euphemism leading to affectation in style, but in his case there was no straining after effect, and it seemed as if he could not help embellishing the substance of his prelections by word-ornament which was not always taken from the vernacular. His love for the beautiful was ingrained in his philosophy, and gave a coloring both to his written and spoken compositions, and the strongest instance of which is exhibited in his work, "Woman: Her Diseases and Remedies," in the form of letters addressed to his Class in 1848.

The author describing to his readers her diseases and the means of cure presents a picture of woman with all her attributes, as a sentient, excitable and imaginative being, easily affected by the surrounding influences of sky and air and social habits, craving for admiration, affection and friendship, charming even in her smaller vanities, and noble in the devoted discharge of domestic and religious duties at every sacrifice. From her come the quickening spirit of the charities and amenities of the world, all that adds grace to civilization, and impels and sustains man in deeds of patriotism and practical philanthropy.

The author illustrates his view of woman's nature by drawing on physiology, psychology, classic lore, and the collateral aids of poetry and the fine arts, with such happy adaptations as to make that which might at first seem to be diffuse and extraneous matter, appear to be a part of the general argument, not merely to show what woman is, but in what variety of channels the physician must carry his scrutiny, and what a variety of means he must enlist for the treatment of her maladies, compounded, as they so often are, of both bodily and mental troubles.

A similar problem, although not quite so complex and puzzling, comes up continually for study and solution in dealing with the diseases of the other sex, and we are forced, after a review of the whole field, to the conclusion, that often, very often, the smaller part of the curative means employed by a physician, consists in prescribing drugs to his patient. But whilst thus abstinent in one direction, he takes higher ground in another, as a minister of nature and expounder of the philosophy of life. The author of Letters to his Class does not fail to speak of woman's early readiness to receive the lessons of Christianity, and the consolation which she subsequently derived from being imbued with its spirit.

He was probably incited to prepare this work by his having, three years before the publication of his Letters, made a translation of the treatise of Colombat de L'Isère on the diseases and Special Hygiene of Females, which he held in great esteem, and in which he introduced notes and additions.

In his intentness to diffuse a knowledge of the subject as taught from his chair on Midwifery and the diseases of Women and Children, in the Jefferson Medical College, he spared no labor, and seemed to invite, as it were, literary and professional rivalry. His next original performance was a treatise entitled Obstetrics the Science and the Art, in 1849, which he wrought *ex cathedra*, with the weight of large experience and discriminative ability.

The Dublin Quarterly Journal declares this work to contain a "vast amount of practical knowledge, by one who has accurately observed and retained the experience of many years, and tells the result in a free, pleasant, and easy manner." A German journal thought that, with some condensation, the volume is well adapted for translation into German. Our American journals abound in their praises of this, as, indeed, of most of the other productions of the author. Following this volume, "Certain Diseases of Young Children," in 1850, and in 1854, a Treatise on Acute and Chronic Diseases of the Neck of the Uterus, with plates, colored and plain; many of the former of them received the touch of his own brush. "Throughout this work," says the Dublin Journal already quoted, "are valuable practical suggestions, as coming from Dr. Meigs," and most of the colored plates are described to be "very beautiful and graphic."

Nearly simultaneous with the appearance of this volume was that on Child-bed Fevers. In the same year, which was that of the second visitation of epidemic cholera in Philadelphia, he gave in a brochure his thoughts on this disease, termed by him spasmodic cholera, for private distribution.

Next in order of time comes his volume on the Nature, Signs, and Treatment of Child-bed Fevers, in 1854. He strenuously advocated the non-contagiousness of Puerperal Fever, and the preference to be given to venesection in its treatment, in both of which views he subjected himself to much opposing inculcation, and severe, abusive critisism. He had, several years previously, indicated his creed on the subject, by bringing to the profession, by an introduction and notes, short monographs by Hey, Armstrong, and Lee, in 1842.

The Treatise on Childbed Fevers was pronounced by the Edinburgh Journal to be superior to any one work upon the same subject.

Memoir on the Ovum, Philosophical Society Transactions, translation from the French of a small volume of Flourens on Phrenology.

Dr. Meigs was no silent member of the different societies with which he became connected. The Records of the Philadelphia College of Physicians, of which he was some years Secretary, the American Philosophical Society, and the Academy of Natural Science, bear proofs of his professional and scientific zeal. Notice has already been taken of the large share he had in editing and contributing to the North American Medical Journal. He was also a contributor to Chapman's Journal of Medical and Physical Sciences, and its successor in due sequence; the American Journal of Medical Sciences; also the Medical Examiner, and the New Orleans Medical and Surgical Journal.

Dr. Meigs, when Secretary of the College of Physicians of Philadelphia, introduced to that body two gentlemen from New England, delegates to represent in different quarters the flood of evil resulting from the use of intoxicating liquors, and to take measures for diminishing its violence and destructive effects, by discontinuing the use of distilled spirits. His own habits always temperate, and finding in a fervid imagination incentives to thought, he never sought the unnatural excitement of the bottle, and hence readily adopted the first steps in the temperance reformation, by his abstaining steadily from the use of distilled spirits, and withholding them, as far as possible, from his patients. He did not carry his detestation of alcohol so far, however, as to inhibit its use in fermented liquors, and tobacco found in him a regular customer.

Dr. Meigs allowed himself but little respite from professional toil, and, with few exceptions, took no vacations, such as are of right, and almost of necessity, the practice of most medical men in the summer months. In the year 1842 he visited Mackinaw and the Falls of St. Anthony, to recruit his almost exhausted energies, and in 1845 he visited Europe for a similar purpose. During a few months absence on this occasion, he made the acquaintance of many of the medical notabilities of France and England, who were prepared, by the reputation which he had acquired, and a knowledge of his works, to receive him with appreciative cordiality. In Paris he read a paper on Cyanosis, in French, before the Academy of Medicine, and received warm commendation from some of the members, not only for his very ingenious view of the subject, but for his good idiomatic and well spoken language on the occasion.

At a later period, in his Treatise on Certain Diseases of Young Children, he enters into anatomical and physiological details, explanatory of the cause of Cyanosis, and of his new method of treating it. The novel feature in the latter consisted in turning the child on its right side, and slightly raising its head and shoulders. Several instances are given by the author of the success of this procedure, which, considering that

Cyanosis occurs under different anatomical conditions of the heart, can only be expected to be serviceable in some of them.

In common with the majority of his fellow-practitioners in Philadelphia, Dr. Meigs was slow in having recourse to etherization in his Obstetric cases, and to the use of chloroform he was opposed to the last; and certainly not without reason, when scarcely a week passes but we hear of death from chloroform, when used as an æsthetic for women in tedious and painful labor, and for surgical operations, some of them of a very slight nature. And the question of anæsthetics was discussed in letters between Sir James Simpson, of Edinburgh, and Dr. Meigs, a pleasant feature of which consisted in the courteous manner in which the parties treated each other.

Dr. Meigs soon won the confidence of his patient by his calm and collected deportment, encouraging speech, and readiness of resources required on the occasion. In the unlooked-for absence of the nurse, and the inability of any female member of the family to take her place, he promptly gave the requisite manual help to both the newly-born infant and the mother. Sometimes his direction and explanation were needlessly interwoven with technical terms, not from any desire to throw words of long and novel sound into the ears of those present, but from a fulness at the moment of language so constantly akin in his own mind to the subject. So far from desiring to shroud his meaning in professional lore, he advocated instruction of mothers and nurses in elementary medicine. The safer and more generally useful learning to be acquired by these parties should be physiology and hygiene, or a knowledge of the means of preserving health and preventing disease, leaving the cure to a fully educated and experienced physician. Advancing years, and the continued wear and tear of professional life, and still more of the Department of Obstetrics to which Dr. Meigs had so long and earnestly devoted himself, could not fail to produce their effects on the strongest body and the most elastic mind, and to begin a grave monition to abate labor, if not to take entire rest. There are few persons, of whatever pursuit or occupation, who do not look forward to the period when they can retire from active business, and end their days in the enjoyment of the long-coveted comforts and ease, in the society of their family and of friends.

The subject of this memoir had long sighed for freedom from his arduous duties of teacher and practitioner, and for leisure to indulge his literary tastes and his fondness for natural science. In proof of the sincerity of his intention to procure these enjoyments, he made preparation by purchase of a piece of land and the erection of a house, five miles beyond Media, in a beautiful region of country. He yielded with pleasant equanimity to the conviction that he was getting old, and determined to avail himself of the compensation which age brings with it. The first step was diminishing his professional labor; the next, the resignation of his Chair in the College. This event took place after the course of 1859–1860, to the regret of his associates and the crowds of students all

all over the land, who had anticipated the pleasure and instructions fro his prelections, on which those in advance of them had descanted lovingly.

In accepting his resignation, the Trustees made him Emeritus Professor, but neither he nor they believed at the time that this honorar distinction would soon be made a ground for the resumption of his labor at the very next session of the College. It so happened, however, tha the gentleman, Wm. V. Keating, who had been appointed his successor and had set about preparing himself for his requisite duties, deeme himself not strong enough in bodily health for their active discharge without being recruited by a visit to Europe during the summer, bu which he deemed it most prudent to prolong for another year. In hi emergency, an appeal was made to the recent Emeritus Professor to fil the unexpectedly vacant chair, and thus repeat once more his lectures Before another scholastic year had begun, Dr. Ellerslie Wallace becam in due course of election the regular successor.

At last Dr. Meigs found himself in the country-home of his ow creation, and free to pass his time in the pleasures of his books an his garden. Of the latter he could say with Dr. Arnold, it was a constant source of amusement both to himself and wife. Our people require to be more frequently reminded of the observation of Sir William Temple, that "gardening has been the inclination of kings and the choice of philosophers, so it has been the common favorite of public and private men, a pleasure of the greatest and the care of the meanest;" and, indeed, continuing to use the illustrious author's own words, "an employment and a possession, in which no man is too high or too low." But a sad break was to be made in this united enjoyment by the death of Mrs. Meigs, which took place on May 13th, 1865.

With her loss he was left to cling more tenaciously to his cherished studies and out-door recreations, while still separating only for a portion of the year from his children and their families in the city, some one of them having him at their homes in winter, and passing the summer with him in the country. Desultory reading soon wearies, and the thoughtful mind finds it necessary to pass even a part of the hours of leisure in reading with a definite object, by bringing the *res disjecta* into shape under a regular literary or scientific garniture. Deep research is not called for to meet the wants of even an already well-read scholar, so much as a method and classification in bringing the several topics and facts in disquisition before him from day to day. Dr. Meigs gained fresh pleasure from the garden, by uniting the study of vegetable physiology with that of the natural groups in Flora's domain, and thus seeing the relation of growth and the varied products for the gratification of the eye and the palate, in flowers, fruits, and esculents.

In ethnology, a new branch of anthropology, the subject of our memoir took a deep interest, affording, as it does, such a wide scope for historic research and inquiry into one's kindred in country and race, the origin and affiliation of the first families of mankind, our remote ancestors, the privileged stock, comparatively small in number to the rest of the population on the face of the earth, but the peoples of which have in all times dominated and shaped the destinies of the rest.

The historian can make but small advances in studying and describing the rise and progress of nations, and their decline and fall, or in finding an explanation of the results of the competitive struggle for empire and domination, unless he shall have acquired a knowledge of the differences of races of mankind, and of their great families or peoples. History, aided by ethnological teachings, is no longer a mere registry of conquests and revolutions. It shows the innate differences in aptitude or capacity for improvement and civilization, irrespective of the external modifying circumstances of locality or climate. In one people we see a rapid germination of the seeds of knowledge, and a subsequent growth and culture, whilst in another people the growth of similar seeds is slower, the plant sickly, and soon decays, while in a third, again, there is no yield—all is barrenness.

Dr. Meigs took great delight in reading and re-reading the work of the Count de Gobineau, "Sur l'inégalité des Races Humaines." Marginal notes show the careful attention which he gave to the utterances of this author, with whom he had a friendly correspondence; and so far did he carry his admiration of the French *savan*, that his very latest literary exercise and amusement was a translation of a work of fiction of the Count's, called "L'Abbaye de Typhanes," intended to exhibit the manners and customs of the people of the 12th century.

Thus, in the midst of his loving family, the endearments of his friends, and the respect of the community, Dr. Meigs filled up the measure of his allotted days. His decease took place on the 22d June, 1869, at the age of 77 years. He had retired to his chamber in the evening at bedtime, making no complaint of any deviation from his usual state of health, except of some pain, for which he took a few drops of laudanum, as he had done on previous occasions for the same cause. As the next morning advanced without his appearing, one of the family went to his room, and saw him lying in bed, with his head resting on one arm, in the attitude of quiet sleep; but it was the sleep of death.

He had breathed his last in the course of the night, without a struggle or a pang, and thus passed from time to eternity, saved from the often protracted bodily and mental distress and pains which fall to the lot of so many, before death comes to relieve them of their sufferings.

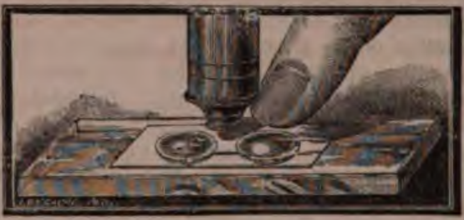
Thus disappeared from amongst us a good man, an estimable citizen, and an accomplished physician, leaving, as a legacy to the world the memory of his wise teachings for the relief of suffering humanity, his own personal labors for the same object, his kindly and disinterested nature, aspiration for the noble and the beautiful, a cultivated intellect, and refined tastes.

D. S. HOLMAN'S DEVICE FOR THE MICROSCOPIC EXAMINATION OF FLUIDS.

By W. Coleman Sellers.

(*Read before the American Philosophical Society, March* 21, 1873.)

In a slip of plate glass 1″ wide, 3″ long, $\frac{1}{8}$ in. thick, two circular concave cells are ground, there being a space of $\frac{1}{12}$ in. left between the cells. These cells, which are about $\frac{1}{2}$ in. in diameter and as deep as the glass will permit—say $\frac{1}{16}$ in. deep—are united by a very shallow channel somewhat below the centre of the two cells, so that with cells placed $\frac{1}{12}$ in. apart, the channel is about $\frac{3}{12}$ in. long. Both the cells and channel are polished. If a few drops of blood be placed in these cells, and a cover of thin glass be pressed down, some of the blood, finding its way between the surfaces in contact, will dry, and act as a cement to hold the fluid blood in the cells in place. The quantity of blood being insufficient to fill the cells, a considerable amount of air becomes imprisoned with the blood, and the expansion of the air in either cell will drive the blood through the channel into the adjacent cell, and in the shallow channel it is presented under the most favorable condition for examination. By holding the top of the finger near one or the other cell, the heat is enough to cause the expansion and a consequent more or less rapid flow of the fluid through the channel. This flow may be arrested or continued and reversed at will by change of position of the finger, so that any particles floating in in the fluid can pass in succession across the field, but can be arrested and examined with ease at will.



Blood or other fluid inclosed in the cells remains in good condition for examination for several days, and changes undergoing in the fluid can be examined.

Mr. Holman exhibited the slide containing human blood, and showed the white corpuscles like the amebæ found in water, and called attention to the change in form of these minute bodies, similar in every way to the amœboid action noticed in the forms found in water, *i. e.*, a change of form, jutting out projections of its body, and consequent entire change of form of the entire body, and by such change, a kind of slow locomotion. Within these amœba-like forms were plainly seen certain minute specks, which had a motion among themselves similar to the so-called molecular motion. Mr. Holman thought it barely possible that these so-called white corpuscles may be in reality veritable amebæ, living in the blood. He stated that the power used was a $\frac{1}{10}$ immersion objective, and with the eye-piece used gave 500 diameters, field being $\frac{1}{100}$ of an inch in diameter, was enlarged to five inches, and in this field he had seen as many as ten of these amœboid forms at the same time. Joseph G. Richardson, M.D., in his handbook of Medical Microscopy, p. 177, says: "One of the most remarkable properties of the white blood globules is their power of amœboid motion, a movement so named because it precisely resembles that of the Amœba, a genus of Infusoria." Then follows a description of the Amœba, taken from the Michrographic Dictionary. Mr. Holman's slide may serve a good purpose in the examination of these curious forms in blood, as it is also convenient in the examination of any uids containing minute forms.

Stated Meeting, April 4th, 1873.

Present, 28 members.

Vice President, MR. FRALEY, in the Chair.

Dr. La Roche and Mr. Henry Pemberton, new members, were introduced to the presiding officer and took their seats.

A letter accepting his appointment to prepare an obituary notice of the late Dr. Hugh L. Hodge was received from Dr. Penrose, dated 1331 Spruce street, March 29th, 1873.

A letter of envoy was received from Prof. J. D. Whitney, dated Cambridge, Mass., March 31st, 1873.

Donations for the Library were received from the Hon. George Bancroft, of Berlin; the Rotterdam S. of Ex. Science; the Bureau des Longitudes, Geographical Society and Revue Politique; the Belgian Academy; the Royal Astronomical Society and London Nature; the Geological Survey of Canada and Montreal Natural History Society; the New Bedford Free Public Library; the American Journal of Science and Prof. O. C. Marsh, of New Haven; the Philadelphia Academy of Natural Sciences, Franklin Institute, College of Pharmacy, Journal of Pharmacy, Penn

Monthly, and Hon. B. H. Brewster; the Regents of the Minnesota University; and the Legislature of California, through the Chief of the Geological Survey.

An obituary notice of the late Prof. John F. Fraser was read by Dr. John L. LeConte.

A paper on Topography as affected by the Earth's Rotation, by W. C. Kerr, State Geologist of North Carolina, was read by the Secretary.

Prof. Cope exhibited specimens of Flat-clawed Carnivora found fossil in Wyoming Territory, and described the same.

Prof. Cope read by title a communication entitled, "On some Eocene Mammals, obtained by Hayden's Geological Survey of 1872."

Prof. Chase illustrated by examples some acoustic, optical and astronomical harmonies which he had been recently investigating.

Prof. Marsh communicated a paper on the Gigantic Mammals of the Eocene of the Rocky Mountain region.

Prof. Marsh read a paper on Prof. Cope's determinations of the dates of papers read before this Society, which he afterwards withdrew by permission of the meeting.

Dr. Coates reported that the Committee on the Library considered it inexpedient to transfer any of the books to any other locality. On motion, the report was adopted.

Mr. Fraley reported that the Committee on Finance had placed the Securities of the Society in safe keeping in obedience to the recent order of the Society.

Pending nominations Nos. 715 to 735 were read.

And the meeting was adjourned.

OBITUARY NOTICE OF JOHN F. FRAZER.

By John L. LeConte, M. D.

(Read before the American Philosophical Society, April 4th, 1873.)

In accordance with the wish of the Society, expressed at the meeting of October 18th, 1872, I have prepared the following brief memoir of John F. Frazer, LL.D., Professor of Natural Philosophy and Chemistry in the University, and who held successively the offices of Secretary and Vice-President in this Society :—a man of eminent scientific and general culture; of singular truthfulness of speech, and integrity of conduct; a devoted lover of consistency in action, and strict performance of duty; virtues which he exemplified in himself and sought for in others.

He was therefore respected by his acquaintances, and beloved by his friends, with whom he interchanged a strong and unselfish affection; one who will live in the memory of those admitted to his intimacy, as of those who have had the good fortune to sit under his instruction.

John Fries Frazer was born in Philadelphia, July 8th, 1812, in Chestnut street, nearly opposite Independence Hall. His father was Robert Frazer, a brilliant and successful lawyer of that time, who married Elizabeth, daughter of John Fries.

He was grandson of Lieut. Col. Persifor Frazer, an active officer in the Revolutionary war.

During his childhood, being placed at school in Philadelphia, he was always among the leaders of his classmates, both in the serious pursuits of the hours of instruction, and in the athletic sports of the recesses. After a year spent, about 1822, at the quasi-military school of Capt. Partridge, in Connecticut, he completed his boyish education under Dr. Wylie, and entered as a student in the University of Pennsylvania.

His acute powers of observation, and the indications of true and manly qualities soon attracted the notice of Prof. A. D. Bache, under whose instruction he now came, and whose influence tended to the development of those scientific tastes, which eventually became the foundation of his continuous work in life. The relations thus established between professor and pupil, resulted, as is rare in the United States, in a tender and permanent affection, which will be referred to at greater length hereafter.

While acquiring his scholastic education, he had the benefit of the most thorough old-time training, which could be obtained in the family of the Rev. S. B. Wylie, D.D., "and in company with his sons, he had been drilled in the classics and mathematics, in a style unknown to these degenerate and superficial days.*"

During his boyhood and adolescence, he was chiefly under the care of his maternal grandfather, John Fries, and afterwards under the general care of Charles Roberts, the father of our fellow-member S. W. Roberts, and of his brother-in-law, the late John Rhea Barton, M. D.

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*Penn Monthly, Nov., 1872, p. 630.

While passing through the academic course of the University of Pennsylvania, and for some time after graduation, he acted as the laboratory assistant of Prof. A. D. Bache; and in this function he aided in determining "with accuracy, for the first time in this country, the periods of the daily variations of the magnetic needle,"* and the connection of the aurora borealis with magnetic forces.

An additional training in physical and natural science was obtained while he held the position of assistant in the Geological Survey of Pennsylvania, under Prof. H. D. Rogers, in 1836.

About this time he perfected his youthful education by a course of law, in the office of John M. Scott, at the end of which he was admitted to practice.

The practice of his profession soon became less attractive than the more laborious, though less remunerative intellectual pursuits, which he had cultivated under the instruction of Prof. Bache. For some time he was Professor in the High School of Philadelphia, when the Professorship of Chemistry and Physics in the University becoming vacant by the resignation of Prof. Bache, Mr. Frazer was chosen to fill the chair. He was then the youngest member of the faculty, and continued to hold the position until his death, when he was the senior Professor, and had been for many years Vice-Provost.

He now devoted himself most industriously to filling the duties of his professorship, and its collateral occupations, among which were many courses of lectures on various branches of physical and chemical science at the Franklin Institute, and the editorship of its Journal, from the year 1850 to 1866; the pages of which, during those 17 years, bear evidence of of his extensive reading and judicious selection from contemporaneous scientific journals of both continents.

He was elected a member of the American Philosophical Society in 1842, and was soon honored with an official position, being made Secretary in 1845, and Vice-President in 1855. He remained in office until the end of 1858, when owing to some unhappy differences which then distracted the Society, he resigned. He was re-elected in 1867, and was afterwards frequent in his attendance at the meetings, taking part in the discussions. which occurred on matters of science and business.

He was one of the fifty original members of the National Academy of Sciences, chartered in 1863 by the Government of the United States: an institution intended to represent the highest scientific culture of the country. The members are pledged to make reports, without compensation, on all subjects of science, on which the opinion of the Academy is required by the Government. After remaining an active member for several years, and serving upon committees, he retired to the grade of honorary member, to make room, as he said, for some more energetic investigator, better entitled to the place.

*Eulogy of Prof. A. D. Bache. by Prof. Joseph Henry. Report of Smithsonian Institution. 1870. p. 7.

The labor of teaching such comprehensive branches of science as Physics and Chemistry, became greatly increased by the rapid developments of modern research, and at length the symptoms of over-fatigue manifested themselves. An obscure affection of the liver had afflicted him for several years, causing frequent and constantly increasing fits of fainting, accompanied with great bodily prostration. In 1856 he was ordered by his physician to seek, in a four months' trip to Europe, a relief which his family and best friends hardly dared to hope would be afforded him. The effect of this brief relaxation was marvellous : not only was he enabled to resume his duties the following autumn with renewed vigor, but the fainting fits did not recur, except in one or two isolated instances, and the development of the hepatic disease seemed to be permanently arrested. Other and equally serious affections resulted from the excessive work to which he again applied himself during the next eleven years, so that another trip to Europe was advised in 1867. This time, sixteen months rest from the labor of teaching, and freedom from anxiety so far restored his health, that on his return, in the autumn of 1868, he was again able to resume the full duties of his chair.

These he continued, without intermission, other than that afforded by the usual vacations, until October 12, 1872, the day following the inauguration of the new University Building, in West Philadelphia. He had taken great interest in this improvement of the institution to which he had given the best labor of his life, and had patiently looked forward to it for opportunities of larger usefulness.

Never, as I have been told by those that saw him on that and the preceding day, had he appeared in better spirits, never more cheerful, although the unusual labor connected with the organization of his departments, and the transfer of the apparatus, with his large scientific library to the shelves in the new building, had entirely exhausted him.

Without premonition of cardiac trouble, which, indeed, though suspected, had never given him any serious inconvenience, and was disregarded in consequence of the graver hepatic disease above mentioned, Prof. Frazer, although much fatigued by the ceremonies of the inauguration of the previous day, went to his laboratory, and having ascended a flight of stairs leading to the apparatus room, dropped suddenly from exhaustion of the heart. Death was instantaneous and although assistance was quickly rendered, all attempts to restore life failed.*

Having thus mentioned the more prominent events in the public life of our deceased associate, it becomes my more difficult and delicate duty to give an analysis of his character, and to exhibit, in however an imperfect manner, the development of the life of usefulness so abruptly terminated.

*By a melancholy coincidence, this sad event took place on the very day on which the writer of this memoir returned after a three years' absence, in the expectation of renewing the warm and long friendship which had thus been interrupted. It was a painful greeting on arriving at home, instead of receiving the hearty grasp of affection, to see the dismal badge of woe on the residence of this valued friend.

The graceful tributes to the memory of Prof. Fraser by those who were closely associated with him in his professorial labors,[*] leave but little to be added by the pen of one far behind them in scholarly practice, and elegance of diction, though yielding to none in his affection for our lamented friend.

Possessed of great animal spirits, with the usual concomitant of restless activity, and inheriting from his grandfather an ample competence, even the great moral power latent in his brain, at the completion of his professional education, might have served for less useful purposes, had it not been for his fortunate attachment to Miss Charlotte Cave, daughter of Thomas Cave, to whom he was married in 1838, at the beginning of his scientific career as a professor. A union which continued during his life, with singular devotion and affection on both sides, and with an influence for good over each, which may be seen but rarely even in the most happily concurrent dispositions. Two daughters and a son are the issue of this marriage, of whom the last has recently been appointed to the chair of Chemistry, resulting from a division of the functions left vacant by the death of his father.

Next in importance to the domestic influence by which he was thus controlled, must be mentioned a very potent encouragement resulting from friendship.

Prof. Frazer combined to a rare extent, correct æsthetic perception with high intelligence, ease in acquiring knowledge, retentive memory, great industry during the hours of labor, and a strict sense of moral responsibility. These elements of a powerful, useful and concientious mind, early attracted the notice of Prof. A. D. Bache, the master spirit of American science in those and later days. Under the genial influences of this interest, the somewhat untamed vital energies of youth were directed to the steady and laborious scientific pursuits of adult age.

It was the happy faculty of our great leader, Prof. Bache, to bind to him by most affectionate ties many of those who had been under his instruction, and it is not surprising that the regard for the tutor and professor of his youth ripened in the soul of Prof. Frazer into reverence and affection for the friend of his mature life.

Thus protected by love, friendship, and a strong sense of duty, he commenced the labor of life, and soon acquired by industry and intelligent facility of communication, power as a teacher in physical and chemical science which has been rarely equalled, and never excelled in Philadelphia. "His mind was quick in its action, and penetration beyond example. No man ever mastered a subject more rapidly, or could explain it more clearly or gracefully to others."[†] "He introduced a thousand anecdotes into his lectures, not only for the purpose of keeping the attention of his scholars awake to the subjects in hand, but to imbue their imaginations with that perfect fairness of judgment and complete collation of the knowledge of men of the past with that of men of the present, by which alone a philosophical character of mind can be formed. This made him a distinguished teacher, and won the confidence as well as excited the admiration of students."*

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[*] Vide Penn Monthly, Nov., 1872, p. 629, for a touching editorial ; ibid. Dec., 1872, p. 728, for full reports of the eloquent remarks at the faculty meeting of the University by Professors Allen, Krauth, Lesley and Jackson.

[†] Allen, Penn Monthly, l. c. sup. 678.

As lecturer at the Franklin Institute he was equally fortunate in the lower, though perhaps nearly as useful sphere of popularizing the different departments of physical science, and rendering them comprehensible to persons who had not the preliminary academic training of college students.

During years of laborious teaching he found opportunity to accumulate, and leisure to read (in addition to his special library of 2500 vols.), a large miscellaneous library, which filled one of the most extensive rooms in his house; and I may freely say that I have known few men who could recall, when occasion required, the material derived from such varied and extensive reading. To him could not be applied the ancient and frequently correct text, "Some there are who possess books, and others that understand them,"† and on many occasions, when enjoying, with other students of science, a discussion on some obscure point of ancient lore, scientific, religious, historical or metaphysical, it mattered not which, I have been amazed with the readiness with which he would define the vague impressions of our somewhat treacherous memories, by turning to the exact page of works rarely referred to, and give us the precise information desired.

He could most happily combine the severe labors of academic teaching with industrious study, and with entire relaxation in the hours taken for social or domestic enjoyment, a power rarely found here, though not unfrequent in older communities.

It was by this happy union of qualities that he was enabled not only to keep himself well informed in the progress of nearly every branch of science, but also to retain the results of the classical instruction he received in his youth from Dr. Wylie.

Quickness of thought, great power of conversation, courtliness of bearing towards women, and brilliancy of wit, made him a most attractive member of society; while the genial manner in which his house was open to his friends on one evening of the week, brought around him a circle of laborers in intellectual pursuits. It was seldom that men of science from other States or countries visited Philadelphia without having a welcome in those weekly gatherings, giving and receiving instruction and sympathy in their respective investigations.

While the country suffered from the unhappy struggle which so nearly produced either its disruption or its entire destruction, Prof. Frazer's adherence to the cause of the Government was most strenuous. Though age and ill-health combined to deprive him of the privilege of active military service, he was among the warmest supporters of the military measures rendered necessary by the colossal proportions of the war. He was one of the early members of the Union League—at that time, a most valuable and unpartizan agent, in giving national effect to local patriotism.

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* Lesley, Penn Monthly, l. c. sup. p. 681.

† Mahabharata, Book I. Section 1. (Annals of Oriental Literature, l. p. 69.)

On religious subjects the information of Prof. Frazer was almost as extensive as on those which engrossed his daily attention. Under Dr. Wylie he had read a moderately complete course of theology, and was as familiar with the books of the Bible, biblical commentaries, and ecclesiastical history as with any other part of his library.

While thus thoroughly acquainted with the varieties of theological opinion which divide the various sects composing the Christian Church, he was, with the modesty inherent in many men of thoughtful mind and earnest intellectual work, not disposed to obtrude his own personal views, or to take part in any argument in favor of the excellence of one sectarian formula over another.

It is also true that his predilection for the Society of Friends rendered him indifferent to the doctrines and human contrivances by which religious bodies are differentiated, under the gradually increasing influence of higher truth upon social evolution. But this very fact only made him more sensitive to the great principles of conduct and feeling which nominally underlie the various religious structures of modern civilization, and to the necessity of practising in himself and exacting from others an intelligent and consistent recognition of these bases of all vitality of the soul. Judged by the standard of conduct, which is the evidence of inward spiritual light, Prof. Frazer was as eminent for his moral as for his intellectual qualities.

The effects of hepatic disease upon the manifestations of moral qualities are well known to every medical man, and it is not singular that despondent feelings, accompanied with great suffering, occasionally overcame his unusually buoyant nature, and produced at times a quickness of manner and a petulance of language which doubtless gave offence to persons who were but slightly acquainted with him, and caused him to be occasionally harshly judged. But those of us who knew him closely, knew also that these were but the momentary effects of pain in a highly susceptible and active organization, which he endeavored to control, though naturally without constant success.

In his charities he was liberal and unobtrusive; ever ready to relieve distress according to his ability; always willing to work for the interests of even an indifferent acquaintance, when something useful or commendable was to be effected. His maxim was, never to neglect what seemed to be the duty of the moment—not to put off the occasion of usefulness that it might recur at a later period. It was a favorite illustration from physical science with Prof. Frazer, that much of the wrong done in the world was not intentional, but occurred from inattention to *moral* *parallax*—that is, by not recognizing the relative importance, subordination, and temporary variations of the manifold duties devolved upon each member of the human family.

"He was a fanatic for truthfulness and fair dealing in science and in everything else, and could not comprehend or make the least allowance for circumstances that threatened to compromise right and wrong. Perfectly fearless himself, and worshipping pluck and courage as the chief human virtues, he gave no quarter to the very shadow of equivocation or unfairness, no matter whom it concerned."*

It should also be observed, that although Prof. Frazer, judging by the history of former systems of thought, was not inclined to adopt as final truth what may prove to be merely scholastic teaching or glosses upon mediæval tradition, he was equally indisposed to cast aside the foundations of thought, resting upon time-honored belief and long experience, in favor of new systems of philosophy, in which the last half century has been so fertile. He required, before a proposition should be received, before it should be allowed to take the place of what preceded, that the facts upon which it was supposed to rest should be well established. A mere hypothesis, however specious, however ingenious, however pleasing to the vanity of human intellect, by explaining to humblest comprehension things not yet within the scope of our highest investigations (though perhaps quite so in the not very remote future), could never with him take the place of actual science.

To superstition on the one side, to rash and ambitious generalization on the other, as to all pretensions and shams of whatsoever nature—scientific, social, political, financial, or religious—he was a most severe enemy; and it was these things, or rather semblances of things—the spectres which afflict and deform our relations with others—that drew out the bitter denunciations which I have alluded to above as being intensified by the pains of disease, though having a natural origin in the honesty of his nature.

On the other hand, I have never heard from him, even in moments of severe suffering, anything that was intended, and very rarely anything that could be construed as personal. His criticisms, like those of the highest and best examples of conduct, were aimed at classes or groups of persons, looking rather for improvement in motive of action than to punishment for individual offence.

On the Monday after his death, Oct. 14th, 1872, the Faculties of Arts and Sciences of the University met to do honor to his memory. Eloquent addresses were made by several of his colleagues, and a series of resolutions were adopted, expressing the severe loss, both to the institution and the community, in the death of Prof. Frazer. Similar action was taken by the Society of the Alumni, and on the next day the body was followed to the grave by an unusually large and respectable assemblage.

Thus has passed from us one of the most highly educated men with whom it has been our privilege to associate—a sad loss to us, and equally so to the community, in which, and for which, he labored with his vast accumulations of knowledge. Without ambition or vain-glory, he was content to give his whole attention to the somewhat monotonous routine of immediate duties in the city, and to be known in the greater world only to those with whom congenial dispositions, similar pursuits, or the accidents of travel had associated him; a combination of modesty, intellect and conscience rarely to be seen. That those who come after us may find in their time an example of equal merit in these qualities, is the fervent wish of all who mourn his lost friendship.

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* Lesley, l. c. sup. p. 81.

TOPOGRAPHY AS AFFECTED BY THE ROTATION OF THE EARTH.

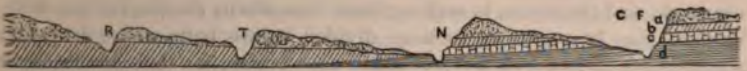
By W. C. Kerr,

State Geologist of North Carolina.

(*Read before the American Philosophical Society, April 4th, 1873.*)

The eastern part of North Carolina, which for about 100 miles from the sea has a comparatively level or very slightly undulating surface, whose slope seaward does not exceed an average of one foot to the mile, is occupied geologically by the (sensibly) horizontal strata of the Post Tertiary or Tertiary formations, which consist of uncompacted sands, clays, marls and gravels in various commixture, and is divided by the southeasterly course of four or five large rivers into as many parallel zones or broad flattish swells, which shed their drainage waters northeast and southeast, by a system of small tributaries, into the larger streams. As may be seen by reference to the map the watershed or crest of these zones lies much nearer to their northeastern margin, dividing them into two very unequal slopes or drainage areas.

In the beginning of my explorations in this region the question was often asked by the more observing and intelligent citizens, why the bluffs and high banks are always found on the south side of the rivers, and swamps and low flats on the north. I did not know, and indeed doubted the fact. But my attention being called to it the observation was soon ascertained to be valid to a very remarkable extent. Another question was also frequently asked which presented a difficulty not obviously connected with the former, viz: why the marl beds (Miocene shell beds) are found only *on the south side* of these large rivers. This observation was also very soon verified as to its general application. Pursuing the subject, it was soon noticed that, as a consequence of this topographical structure, the great roads as well as the towns and residences on these streams are located very generally on the same side, as may be seen by a glance at the map of the State. Another curious point may also be noted here; each of these rivers, between the point where it enters the champaign and its mouth, makes a gradual sweep towards the south (some of them more than one); so that they consist of one or more curves, whose convexity is turned southward, presenting the appearance on the map of a succession of catenaries hung between two or more fixed points. A cross section of these interfluvial zones will present about the following appearance:



Ideal section across the Roanoke, Tin, Neuse and Cape Fear Rivers; d, Cretaceous; c, Eocene; b, Miocene; a, Quaternary.

In seeking an explanation of this peculiar topography, the theory of a gradual subsidence towards the south was first considered. The objections to it however were obvious and insuperable. Finding the same observation to hold for the corresponding region of South Carolina, I consulted the Geological Report of Prof. Tuomey. He had noted the facts and their persistence through more than one State, but had rested in the theory of an unequal subsidence. The sufficient objection to this explanation is that there is no evidence of such a subsidence, but much evidence that it could not have taken place without producing a very observable difference in the present horizon of the formations affected. And furthermore, the phenomenon is not confined to the superficial strata of the Quaternary or Tertiary formations. If the covering of these were removed, a section of the Cretaceous would present the same appearance. The cause, therefore, whatever it be, has acted over a very large territory through a very long period. That cause is doubtless the rotation of the earth, coäcting with the force of the river currents. Without stopping to refer to familiar instances of the sensible operation of this cosmical force in modifying the motions of projectiles, it is sufficient to refer to the well-known law of motions developed by Prof. W. Ferrel in the Mathematical Monthly, vol. i. p. 307, according to which, "In whatever direction a body moves on the surface of the earth there is a force arising from the earth's rotation which deflects it to the right in the northern hemisphere, but to the left in the southern."

To the obvious objection that the deflective force of the river current is too inconsiderable to produce such effects, the equally obvious answer is, that though the force be small, it has been active for a very long period; and moreover, it may be added, since these river valleys were doubtless scooped out mainly, (as is apparent even from the above section), during the (early part of the) drift or ice period, when the volume and velocity of their currents were immeasurably greater than now, the deflective force of these currents was far from infinitesimal in amount, or insensible in aggregate effect. These river valleys were excavated while the region was elevated more than one (probably several) hundred feet above its present level, and afterwards silted up during the later ages of the Ice Period, when it was sunk to a depth of more than 400 feet lower than now, and then re-excavated as the continent rose the second time from the sea. At the close of the Tertiary, when the coast was elevated so as to bring this territory above the waters of the Atlantic, the surface was doubtless left comparatively level with a gentle slope seaward; and the rivers, in seeking their channels by the lines of quickest descent, may be supposed to have divided it into belts whose drainage surfaces north and south were about equal. But as their course was over the surface of uncompacted sands, clays, &c., these currents, by the incessant impact of their waters upon the right bank would gradually, but more and more slowly, eat their way southward. Whenever an obstacle was encountered in this southward movement, in the form of resisting clays, compacted earths or projecting rocks, the course of the river above would be thrown into a curve with its convexity to the south.

It is obvious that under similar conditions these phenomena must be observable elsewhere, that is, in regions where wide level tracts of unconsolidated earths have been traversed for long periods by strong river currents, especially by the floods of Glacial and sub-glacial times. And even in regions occupied by the older rocks the effects of this force of the earth's rotation may manifest itself, for example, in latitudes where the decomposition of the rocks more than keeps pace with the abrasive and transporting power of the meteoric waters. The middle region of North Carolina furnishes an illustration. Observant farmers who have been long accustomed to haul their produce to South Carolina, across the course of the principal streams, have asked me why they had all the worst hills to ascend going to market and only moderate acclivities *returning*. In this region the rocks are concealed by a thick covering of earth, 30 to 50 feet and more, (resulting from their decomposition in situ); so that the conditions being somewhat similar to those existing near the coast, the topography may be supposed to have been affected to some extent by the rotation. If this theory be valid, of course it will receive confirmation from observations in other parts of the world where the proper conditions coexist, "and if not, not."

THE MUSIC OF THE SPHERES.

BY PLINY EARLE CHASE.

(Read before the American Philosophical Society, April 4th, 1873.)

The cumulative evidences of a commensurable unity of law, in atmospheric tides, gaseous explosions, sonant and luminous vibration, molar and molecular inertia, satellite distances, solar and planetary rotation, gravitating and magnetic action, encourage a more minute investigation into the character of the planetary and stellar harmonies.

We are at present unable to introduce any considerations connected with the velocity of gravity, except the probability that it is uniform at all distances. It seems reasonable, however, to extend the oscillatory hypothesis to all primary forms of force, and to suppose that there may be some tendency to harmonic vibrations, of inconceivable velocity, which may have contributed both to the original arrangement and to the present stability of the solar system.

I have already shown[*] (*ante*, xii, 518–522) a disposition to aggregation in accordance with the coördinates of logarithmic curves, not only within our immediate system, but also in the interstellar spaces. The same tendency is seen in the differences of atmospheric pressure at different altitudes, being a necessary consequence of gaseous or other analogous elasticity. I have also shown, in the foregoing communication on "Oscillatory Forces in the Solar System," that the alternate planets, commencing at either end of the series, are arranged in a more obvious geometrical progression than the intermediate planets, but that all appear to be posited by simple oscillatory laws.

A closer scrutiny has detected additional relations, involving not only the typical ratio between uniform luminous and gravitating motions (π), and the ratio of linear oscillation (3), but also, at the centre of inertia of the planetary belt, the ratio between the squares of the distances of comparable actual and virtual fall $\left(\frac{\pi^{2}}{8}\right)$[*]. The compared velocities being uniform, the distances vary as the times; but the distances fallen through by gravity, vary as the squares of the times, and, consequently, as the squares of the distances in uniform velocities. The difference between π and 3 is so slight, that there might, perhaps, be some room to question which of the two ratios is the more influential; but the following comparisons seem to show that the ratio of linear oscillation is, perhaps, slightly predominant:

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[*] See foregoing communication on "Estimation of Solar Mass and Distance from the Equilibrium of Elastic and Gravitating Forces."

I. ALTERNATE PLANETARY SERIES.

	Theoretic.	Observed.	Ratio.	Mus. Interval.*
Neptune...............	30.043	30.037	3.149	3.174
Saturn................	9.563	9.539	3.130	3.174
Mean Asteroid........	3.044	3.047	3.047	2.996
Earth, perihelion......	.969	.966	3.137	3.174
Mercury, "	.308	.319		
Earth, mean..........	1.000	1.000		
Uranus................	19.231	19.183	3.687	3.776
Jupiter................	5.196	5.203	3.416	3.364
Mars..................	1.522	1.524	2.106	2.118
Venus.................	.711	.723		

The closeness of approximation between the theoretic and observed values, and the near accordance of the ratios to musical intervals, induced me to apply the test of a harmonic progression, based upon the centre of linear oscillation ($\frac{2}{3}$), the general expression for the several terms being $\frac{2}{3n}$. I found that the mean planetary positions could be indicated by terms of such a progression, even more precisely than by Bode's law, inasmuch as the asteroidal belt is skipped, and additional light is thrown upon planetary eccentricities.

We have therefore three coördinate agencies, one of centrifugal oscillation, represented by my modification of Bode's law; one of centripetal oscillation, represented by the above harmonic law; and one of uniform gravitating oscillation, combined with the square of the ratio of the time of fall to the time of revolution, represented by $\frac{\pi^n}{32}$. The two former series seem to be attributable to the combined centripetal and centrifugal activities, at the two principal centres of inertia in our system, Sun and Jupiter. I therefore take the mean perihelion distance of Jupiter as the *point d' appui* of my harmonic series, and construct the Bode series in such manner that its sum shall be equivalent to the corresponding harmonic sum. The importance of the $\frac{\pi^n}{32}$ series, is obvious at a glance. The doubling of the second term of that series, to give the bracketed mean distance of Uranus, and the halving of the third term, to give the bracketed mean distance of Mars, are curiously suggestive.

In the following table, *m* denotes mean distance; *p*, perihelion; *a*, aphelion. The musical intervals represent the number of semitones in the ideal scale, proportionate to the corresponding theoretic planetary distances from Jupiter's mean perihelion. The planetary eccentricities are subject to such variations, that it is obviously important, in a preliminary comparison of this kind, to consider the secular *mean* aphelia and perihelia.

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*According to the ideal scale in which each semitone is $\sqrt[12]{2}$.

II. TRIPLE PLANETARY SERIES.

		Observed.		Harmonic.	Bode.	$\pi^n \div 32$	Intervals.
Neptune,	*m*	30.0370				$\pi^6 \div 32 -$ 30.0435	31
"	*p*	29.7353	6 × ♃ *p*	29.8692	29.5303		30
Uranus,	*a*	20.0432	$\frac{2}{3}$ ♆	19.9128	19.8218		24
"	*m*	19.1826				[$\pi^5 \div 16 -$ 19.1262]	22
Saturn,	*a*	10.	$\frac{2}{6}$ "	9.9564	10.1131		12
"	*m*	9.5389				$\pi^5 \div 32 -$ 9.5631	11
Jupiter,	*m*	5.2028			5.2588		1
"	*p*	4.9782	Base	4.9782			0
Asteroid — 2♂		3.0440			2.8317	$\pi^4 \div 32 -$ 3.0440	$8\frac{1}{2}$
Mars,	*a*	1.6442	$\frac{2}{36}$ ♆	1.6594	1.6181		18
"	*m*	1.5237				[$\pi^4 \div 64 -$ 1.5220]	$20\frac{1}{2}$
Earth.	*m*	1.	$\frac{2}{60}$ "	.9956	1.0133		28
"	*p*	.9661				$\pi^3 \div 32 -$ .9689	28
Venus,	*m*	.7233	$\frac{2}{84}$ "	.7112			34
"	*p*	.6978			.7079		
(♀ + ☿) ÷ 2		.5552	$\frac{2}{108}$ "	.5531			38
Mercury,	*a*	.4555	$\frac{2}{132}$ "	.4526			$41\frac{1}{2}$
"	*m*	.3871	$\frac{2}{156}$ "	.3829	.4045		$44\frac{1}{2}$
"	*p*	.3187	$\frac{2}{180}$ "	.3319		$\pi^2 \div 32 -$ .3084	47, 48
Sum, Theoretic				69.8033	68.4658	64.5761	
" Observed				69.8407	68.7104	64.6110	

The significance of the above table may, perhaps, be increased, by the following considerations:

1. Each series *precisely* represents actual planetary positions.

2. The combined influence of the three series is such as to produce planetary eccentricity, and to give an approximate value of such eccentricity for each planet.

3. In centrifugal emanation and centripetal acceleration, the uniform velocity of radial light and circular revolution, orbital inertia and tendency to centres of linear oscillation, elasticity and harmonic undulations in elastic-media, there are *verae causae* which might lead us to look for each of the three series.

4. Each series seems to exert a nearly equal influence upon the planetotaxis, as is seen by the observed and theoretic sums.

5. The accordance between the theoretic and observed values, is almost precisely equal in the harmonic and circular series (within about $\frac{1}{19}$ of one per cent.) and more than six times as close as in the Bode series (more than $\frac{1}{3}$ of one per cent).

6. The two predominant gravitating tendencies in the solar system are towards the Sun and towards Jupiter.

7. The centre of gravity of the Sun and Jupiter is at about 1.066 × solar radius from the Sun's centre. The mean aphelion centre of planetary inertia (9.6615) is about 1.069 × the mean perihelion centre. Jupiter's mean eccentricity (.0432) is about $\frac{2}{3}$ × the solar-jovian eccentricity (.068).

8. The mean perihelion distance of Jupiter corresponds with the distance of a planetary revolution which would be synchronous with the mean sun-spot period. The mean perihelion of Saturn (9.078), corresponds with the mean perihelion centre of planetary inertia (9.039).

9. The eighth term of the $\frac{\pi^n}{32}$ series (2.137 × solar radius), is equivalent to about twice the distance of the solar-jovian centre of gravity (1.066). The third term of the same series is about twice the mean radius vector of Mars.

10. The Saturnian year is to the terrestrial year, nearly as the solar rotation is to terrestrial rotation, or as solar is to terrestrial superficial gravity.

11. The harmonic series between Jupiter and the inner limit of the planetary belt ($\frac{1}{1}$, $\frac{1}{3}$, $\frac{1}{5}$, $\frac{1}{7}$, $\frac{1}{9}$, $\frac{1}{11}$, $\frac{1}{13}$, $\frac{1}{15}$), is remarkably simple. If we interpolate as many harmonic means between each of the terms, as are equivalent to the number of remaining planets (7), the series may be extended to the outer planetary limit.

12. The ultra-jovian series (2, 4, 6, ♃ ; or $\frac{2}{6}$, $\frac{2}{4}$, $\frac{2}{2}$ Ψ) renders each of the supra-asteroidal planets subservient to the stability of the system. For if all the exterior planets were in conjunction, Jupiter would be near the centre of linear oscillation, between their centre of gravity and the Sun; when Jupiter and Saturn are in opposition, Saturn, moving more slowly than Jupiter, may be regarded as somewhat pivotal, and the Sun is near the centre of linear oscillation; the Sun is also near the centre of linear oscillation when Saturn and Uranus are in opposition; Uranus is near Neptune's centre of linear oscillation, when those two planets are in conjunction, and the time of luminous oscillation between Uranus and the Sun's surface, appears to be *precisely* coincident with the time of planetary oscillation at the Sun's surface.

13. The Bodeian, Circular, and Harmonic Series, all concur in indicating alternate planetary positions, except in the asteroidal belt, which is at the extremity of linear oscillation when Jupiter and the Sun are regarded as fixing the length of the simple pendulum.

14. The eccentricity indicated within the asteroidal belt [(3.044 − 2.832) ÷ 2.832], is nearly equivalent to the mean eccentricity of Mars (.079). The Bodeian asteroidal term represents twice the mean perihelion distance, while the circular term represents twice the mean distance, of Mars (2.8317, 2.8064; 3.044, 3.047), and, very nearly, the ratio of Jupiter's mean perihelion to Mars's mean distance (3.028).

15. The inner limit of the asteroidal belt is near the linear centre of oscillation of the outer limit.

16. The musical intervals are generally such as to produce chords between any two adjacent theoretical planetary positions. But where quarter-tones occur, the discordant vibrations seem to have broken up or disturbed the tendencies to planetary aggregation, aiding in producing the asteroidal belt, giving Mars and Mercury their great eccentricity, and obliterating the planet between Mercury and Venus.

17. Centres of linear oscillation are found within the asteroidal belt at the oppositions of Neptune and Uranus, Neptune and Saturn, Uranus and Jupiter. The immense inertia of the Sun seems, in each of these cases, to have disturbed, without wholly destroying, the tendencies to planetary aggregation.

18. A careful examination shows numerous other perihelion, mean, or aphelion distances, connected with centres of linear oscillation, some of which I propose to enumerate in a subsequent communication.

19. Saturn's mean aphelion (10) is a mean proportional between Jupiter's mean perihelion (4.978) and the mean aphelion of Uranus (20.043), as well as between Uranus's mean perihelion (18.322) and Jupiter's mean aphelion (5.427).

20. The geometric mean of the theoretical harmonic planetary distances (2.13716), varies less than one-fortieth of one per cent. from the geometric mean of the actual planetary distances (2.13665). This approximation corresponds in precision to the one given, in my paper on "The Gamuts of Sound and Light," between the mean wave length of the Fraunhofer lines and those of the musical Scale.

21. The inner limit of the asteroidal belt (Flora = 2.2) is nearly coincident with the geometric planetary mean.

22. The year at the harmonic theoretical aphelion of Mars ($1.659^{\frac{3}{2}} = 2.1376$), is to the terrestrial year, as the geometric planetary mean is to the Earth's mean radius vector. By means of this ratio, Pierce's Phyllotactic series may, perhaps, be connected with the harmonic series.

23. The linear centre of oscillation of Jupiter's radius vector, and the shorter extremity of the solar-jovian linear pendulum of which the Sun occupies the centre of oscillation, are both in the asteroidal belt.

24. The potential of *vis viva* in a gravitating mass (mv^2) varies as the product of the mass by the distance (md, or at the surface, mr), therefore the product of the mass by the radius may, perhaps, represent the limiting excursion of communicated elastic undulation at the surface. Such is at least the case, if the theoretical velocities of sound and light are the limiting velocities at the Earth and Sun.

25. The velocity communicated, during a given angular rotation, by Earth and Jupiter (the controlling orbs of the intra and extra-asteroidal systems) to falling bodies at their surface, is to the velocity communicated by the Sun, in an equivalent angular rotation, as planetary velocity at the Sun's surface, is to the velocity of light.

26. The centres of linear oscillation between Neptune's mean aphelion and Uranus's mean perihelion (2.1019), and between Neptune's perihelion and Uranus's aphelion (3.4503), are near the apparent inner and outer limits of the asteroidal belt.

It gives me great pleasure to acknowledge my indebtedness to Stockwell's discussion of the secular variations of the planetary elements, for the amount of verification his results have afforded to my hypotheses. I subjoin his determinations of the mean eccentricities, and the mean perihelia and aphelia which represent those determinations.

	E	*p*	*a*		*E*	*p*	*a*
Mercury,	.1766064	.3187	.4555	Jupiter,	.0431601	4.9782	5.4274
Venus,	.0358165	.6978	.7489	Saturn,	.0483504	9.0777	10.
Earth,	.0838676	.9661	1.0339	Uranus,	.0448614	18.3221	20.0432
Mars,	.0790650	.14032	1.6442	Neptune,	.0100389	29.7353	30.3385

ON THE FLAT-CLAWED CARNIVORA OF THE EOCENE OF WYOMING.

BY EDWARD D. COPE, A. M.

(*Read before the American Philosophical Society, April 4, 1873.*)

MESONYX. Cope.

This genus was described by the writer in the Proceedings of the American Philosophical Society for 1872, p. 460. It was there referred to the *Carnivora*, and stated to resemble *Hyænodon* in some respects. I propose on the present occasion to attempt a more exact determination of its structure and relationships. The only species yet certainly referable to it is *Mesonyx obtusidens*, Cope, l. c., which is represented by a fragmentary skeleton. There are preserved, portions of the skull with the teeth, chiefly mandibular; numerous vertebræ from all parts of the column; parts of scapula, ulna and fore feet; portions of pelvis, femora, tibiæ, tarsals, metatarsals, and phalanges.

The numerous unguiculate digits, the sectorial character of the molar teeth and the characteristic form of the astragalus demonstrate this genus to belong to the *Carnivora fissipedia*. It becomes interesting then to determine the relations of an Eocene type of the order to the families now living.

The cervical *vertebræ* are damaged. The dorsals are strikingly smaller than the lumbars, being less than half their bulk. They are opisthocœlian with shallow cups, and the centra are quite concave laterally and inferiorly. The centra of the lumbars are more truncate, with a trace of the opisthocœlian structure, and are quite depressed in form. The median part of the series is more elongate than in the corresponding vertebræ of the genus *Canis*. They exhibit an obtuse median longitudinal angle, on each side of which, at a little distance, a nutritious artery entered by a foramen. The zygapophyses of the posterior lumbars have interlocking articulations, the posterior with a convex exterior articular face, the anterior with a concave anterior one. The sacrum is not completely preserved, three coössified centra remain. These are more elongate and the diapophyses have less expansion than in *Felis*, *Hyæna*, *Canis* or *Ursus*. They are much flattened, and the middle one has two slight median longitudinal angles. The caudal vertebræ indicate a long tail, with stout base. Its proximal vertebræ are depressed, and with broad anteriorly-directed diapophyses. The more distal vertebræ have sub-cylindric centra; the terminal ones are very small.

The glenoid cavity of the *scapula* is shallow; the coracoid process is a short hook separated by a strong groove from the edge of the former. The spine is well developed. In the character of the coracoid, this genus resembles *Felis* more than *Canis* or *Ursus*. The ulna exhibits little trace of articular face for the radius, less than in *Felis* or *Canis*. Its humeral glenoid face is more convex transversely in its anterior or vertical portion than in those genera, and a little more than in *Ursus*. In the hind limb the *femur* resembles that of other *Carnivora* in all essentials. The rotular groove is narrow and elevated, the inner margin a little higher. The condyles are rather narrow, the inner with less transverse and antero-posterior extent, and separated by a wide and deep fossa. The patella is narrow, thick, and truncate at one end. The proximal end of the *tibia* exhibits a very prominent and well elevated crest or spine, which bounds a deeply excavated fossa. The articular faces are separated by a deep notch behind; the external is a little the larger and is produced into a point outwards and backwards; it lacks the notch of the antero-exterior margin so distinct in *Canis*, but possesses an emargination at the outer base of the crest homologous with it. The general form is, however, more like that of *Canis* than of *Felis*, and least like that of *Ursus*. The distal extremity of the tibia presents Carnivorous characters. The two trochlear fossæ are deeply impressed, the outer wall of the external one being formed by the fibula only. The anterior marginal crest is more elevated than the posterior, and presents an overlapping articular face between the fossæ for a corresponding tuberosity of the neck of the astragalus. The inner malleolus is entirely without the groove for the tendon of the *tibialis posticus* muscle, and therefore different from many of the digitigrade *Carnivora*. It has an ovate truncate surface. On the anterior face opposite the inner trochlear groove is a rather small but deep fossa.

The *astragalus* has an elongate oblique neck and a navicular extremity slightly expanded inwards. The trochlear ridges are well elevated, and not very oblique to the true vertical plane, being much as in the dog. The distal extremity is quite different from *Felis*, *Hyæna*, *Canis* and *Ursus* in having a rather narrow convex facet next the cuboid bone extending from front to rear, and in having the navicular facet pulley-like or slightly concave in transverse section, while it is strongly convex antero-posteriorly. This is part of the peculiarity presented by the hind foot in this genus. Behind the navicular facet, on the superior face, is a tuberosity which stops the flexure of the foot by contact with the tibia; a trace of it is seen in the dog. The calcaneum has the compressed form of the digitigrades, but the broader interval, and convex external astragaline facets resemble much more those in the bears. The cuboid facet is a frustrum of a triangle with the apex directed inwards and downwards.

The *metapodial* bones are rather elongate, and flattened so as to be transverse in position. A second metatarsal is more flattened than corresponding bones of *Canis* and *Felis*. Its cuneiform facet is somewhat concave transversely. The phalangeal condyles are furnished with an anterior and inferior carina, which is wanting above; the articular face is wide above as in *Canis*, and is bounded by a transverse fossa as in digitigrade genera. The phalanges of the first series are elongate and curved as in *Felis*, being relatively longer than in *Ursus*. Phalanges of the other series are quite short. The ungues are short and flattened, their inferior surface is nearly plane, and the superior but little convex. A shallow groove divides the upper face longitudinally to the extremity. The margin below is acute to a slightly contracted neck. There is no indication of collar for reception of the horny sheath, except perhaps a slight area of fracture on each side, and there is no projecting tuberosity below for insertion of flexor tendon. The middle of the proximal part of the unguis is a raised plane, and on each side of it, at the neck, two arterial foramina enter. There is a small foramen in the groove, and several smaller ones near the margin. These ungues resemble somewhat those of some tortoises. They were found with the other phalanges, with which they agree in size and articulation, and no doubt belong to the same animal. It is evident that they differ in character from those of most existing *Carnivora*. The penultimate phalanges agree with them in the depressed form of their proximal articular faces, wanting entirely the triangular form so characteristic of *Carnivora*, especially of the cats and dogs. The short flat shaft of the same is almost equally peculiar.

The *cranium* is fragmentary. The malar bone of the right side is similar in position and form to that of the *Canidæ*, especially in the presence of a weak angle only, to mark the posterior border of the orbit. It has a much less expanded union with the maxillary than in these animals, and is proximally shallower, thicker and more prominent. Its posterior portion is more plate-like.

There are numerous *teeth* preserved, but separate from the skull and mostly mandibular. The inferior canine is stout especially in the root, which is a flat oval in section. The crown is but little curved, slightly compressed, and without edge or groove. The premolars graduate into the molars, so that the line of distinction is not easily drawn. The first premolar has a single root; the crown is slightly conic, with a small tubercle at the base behind. This tubercle increases in size on the premolars 2 and 3, and becomes on the true molars a longitudinal cutting edge extending along the axis of the crown, not much elevated above a wide base. It occupies half the length of the crown in the larger molars, and is preceded by an elevated conic cusp. In front of the base of this, a small conic tubercle projects forwards, which appeared as a rudiment on the third premolar. The number of mandibular teeth would appear to be, P. M. 3, M. 4. No portions certainly referable to the superior molars were found.

Conclusion. In summing up, it may be accepted as a result of the above analysis that the genus *Mesonyx* represents a family of *Carnivora digitigrada*, distinct from any now living on the globe. The form of the astragalus renders it probable that the inner toe is wanting or rudimental, and that there were four digits on the hind foot. The foot was also short and the claws flat, and altogether without prehensile use, but rather adapted for aquatic life. The number of molars exceeds that in any recent family of *Carnivora* except the *Protelidæ*, and their sectorial form allies it at once to the extinct *Hyænodontidæ*. To this family the genus *Mesonyx* may indeed be for the present referred. Among recent families it approaches nearest the *Canidæ*, but has structures borrowed from others, while its numerous molars constitute a point of greater generalization than any. Although sectorials, this character is not nearly so marked as in the existing *Carnivora*, the cutting edge being obtuse and occupying half the crown only, while the elevated cone occupying the remainder distinguishes the genus from these and from *Hyænodon* also. The lobe corresponding to this cone is preceded in *Hyænodon* by a cutting edge, in *Mesonyx* by a tubercle.

MESONYX OBTUSIDENS. Cope.

Proceedings American Philosophical Soc. 1872, 460 (August 15th).

This species was as large as our largest wolves. While the proportions of the limbs were not very different, the form was rather more slender behind. The orbit was smaller, and the cheek bone more prominent than in those animals. The long tail added to the general resemblance to the dogs. The measurements are as follows :

	M.
Length malar bone	0.073
Depth " in front	.016
" " at postorbital angle	.023
" " middle of orbit	.015
Thickness " " "	.013
Transverse diameter glenoid cavity of scapula	.025
" " ulnar do. for humerus	.014
Length centrum dorsal vertebra	.019
Diameter " transverse	.018
" " vertical	.014
Length centrum of a median lumbar	.030

	M.
Diameter centrum transverse	.025
" " vertical	.016
" " " first sacral	.014
" " transverse "	.026
Expanse of do.	.046
Length of two sacral vertebræ	.049
" proximal caudal	.022
Expanse diapophyses "	.036
Diameter centrum do., vertical	.009
" " transverse	.015
" " distal caudal, vertical	.007
" " do., transverse	.007
Chord of femoral trochlea and condyles	.038
Width trochlear groove	.013
" condyles	.029
" tibia proximally	.038
Diameter do. antero-posteriorly	.039
" shaft, .050 M. from end	.017
" distal extremity transversely	.026
" " " antero-posteriorly	.018
Length patella	.025
Width "	.015
Length astragalus	.030
Width " above	.016
" " distally	.017
" " neck	.012
" cuboid facet of calcaneum	.016
Depth " " "	.011
Width of a second metacarpal (shaft)	.012
Depth " " (head)	.014
Width " " distal end	.010
Length proximal phalange	.0290
Width proximally	.0100
" " of a penultimate do.	.0085
Length " "	.0110
Length ungueal phalange	.0150
Width medially	.0065
" proximally	.0070
Length crown of canine tooth (worn)	.0200
Diameter of base fore and aft	.013
" premolar (1) "	.006
Length crown do.	.006
" base premolar (2)	.011
Height crown "	.009
Length crown true molar	.018
Width " "	.008
Height of cutting edge	.005

There are no cingula on the teeth, and the enamel is perfectly smooth. The appearance of the crowns as well as the bones indicates an adult animal.

The bones of this animal were found together on the bluffs of Cottonwood Creek, Wyoming, by myself while attached to Hayden's Geological Survey of the Territories for 1872.

SYNOPLOTHERIUM. Cope.

Proceedings American Philosophical Society, 1872, page 483, read September 20th, 1872.

Represented as yet by a single species, which is known from fragmentary remains of a single individual. The portions preserved are: a large part of the skull with nearly complete dentition, the superior molars loose; lumbar and caudal vertebræ; large portions of both fore limbs, including the bones of the feet; smaller portions of the hind limbs and feet.

The bones of the *fore limbs* are stout in their proportions. The *humerus* has a well marked rugose line for muscular insertion on its posterior face, but no prominent angle. Distally the inner and outer condylar tuberosities are almost wanting, and there is neither external aliform ridge, nor internal arterial foramen. The olecranar and coronoid fossæ are confluent, forming a very large supracondylar foramen. The condyles are moderately constricted medially, and there is a well marked submedian rib separated from the outer condyle by a constriction. The latter is continued as an acute ridge on the outer side of the olecranar fossa. The inner condyle is the more prominent and its outer margin is a sharp elevated crest. The *ulna* has a very prominent superior process, continuing the cotylus upwards. The coronoid process, on the other hand, is rather low. The radial cotylus is flat and broad. The distal end is not preserved. The *radius* has a more transverse head than *Canis* or *Felis*, and has three articular planes, the inner being a wide oblique truncation of the edge. The shaft is angulate below, and becomes a little deeper than wide near the distal end. The extremity is lost. The *carpal* bones are probably all present. The fore foot was found in place so that the relations of the bones are known with certainty. The scaphoid and lunar appear to be distinct. The former exhibits proximally the inner tuberosity, then a slight concavity, and then the convexity, where it is obliquely truncated so as to give a general rhomboid outline. Beneath there are but two facets, the inner the deepest, and divided lengthwise by the truncation of the bone. The larger facet fits correctly the 0.0. trapezium and trapezoides. The lunar was not found in its place, but two fragments taken from the matrix just behind it, adhering to the pisiforme, probably belong to it. The upper face is convex. The cuneiform is large and concave lengthwise above for the narrow extremity of the ulna. Below it has a large concave facet for the unciform. The pisiforme is of unusual size, and is as stout as the largest metacarpus, and nearly half as long as the outer (5th) metacarpal. It articulates with a thick V-shaped facet of the cuneiform. Its extremity is obtuse and expanded. The trapezium is large and attached to its metacarpus laterally, sending a process downwards posteriorly. It supports a narrow articular surface for the metacarpus of a small pollex or inner digit, which is not preserved. The trapezoid is smaller and of a triangular outline, with the base forwards. The magnum is a rather small bone articulating as usual with the metatarsals 2 and 3. It is depressed in front. The unciform is a large bone with a considerable external anterior surface. Two-thirds of its upper surface is in contact with the cuneiform, the remaining part projecting upwards with convex face to unite with the lunare. Below it supports metatarsals 4 and 5.

There were probably five digits of the fore foot, the inner small or rudimental. The proportions are stouter than in the dogs, but not so much so as in the bears. The *phalanges* have a length similar to that seen in some bears, but the metatarsals are more elongate. The lengths of the latter are, fifth shortest, then 2d, 3d and 4th. Their condyles are broad, with median keel behind, and shallow supracondylar fossa in front. The first phalanges are about one-third the length of the metacarpals; the second of digit No. 2 broad and stout and half as long as the phalange of the first row. An ungueal phalange has a singular form, so that the claw might be supposed to have a subungulate character. It is flat, considerably broader than high and with expanded and obtuse extremity. The articular extremity is depressed and transverse concave in vertical, convex in transverse section. The anterior three-fifths of the superior middle line is occupied by a deep gaping fissure, which separates the extremity into two points. The inferior face is entirely flat, there being no tendinous tuberosity. The sides are grooved, and give entrance each to a large arterial foramen proximally. These claws resemble those of *Mesonyx*, and differ remarkably from those of existing terrestrial *Carnivora.*

Of *hinder limb* the only characteristic pieces remaining are the navicular, cuboid, and an external cuneiform bone. The cuboid is rather stout, with a slight concave facet at one extremity and two at the other, one of them smaller and sublateral. The navicular is wide and flat, and with a strongly concave astragaline facet. Below, it presents two deep oblique concave facets for the cuneiforms, with a small sublateral one on the outer side. The facets of the cuboid and astragalus indicate four well developed digits and another perhaps smaller one. Thus in this genus they were on both limbs probably 5–5, with the inner small.

The *cranium* is fractured above. There remain the squamosal and periotic bones, occipital condyles, malar and part of maxillary, both premaxillaries and the greater part of both mandibular rami. The squamosal process of the zygoma is produced inferiorly far below the auditory meatus, even further than in the bears. Its proximal portion includes, on the lower face, a strong groove at right angles to the axis of the cranium, with its defining margins acute and prominent. This is the transverse glenoid cavity of the carnivorous type. The zygoma has a wide curvature indicating a powerful temporal muscle. The posterior angle of the malar extends well posteriorly. Its anterior portion projects, forming a longitudinal rib; there is no produced postorbital process. The tympanic bone is produced upwards and outwards and forms a tube with everted lips. The opisthotic (mastoid) separates it entirely from the exoccipital, and overlaps the posterior half of the tube by a laminar expansion. A pit in this bone near the *meatus externus* represents the insertion of the stylohyal ligament. There is no bulla, the tympanic chamber being small and with thick walls. The character of this region forbids the idea of any tapiroid affinities on the part of this genus, and resembles that seen in the bears more than that of any other carnivorous type.

The *premaxillaries* are vertico-oblique in position, presenting the nareal opening directly forwards as in cats, but with a still less prominent alveolar border. The horizontal part of this border is indeed very short, including but two small incisors. It then rises vertically, and turns obliquely backwards to the maxillary, enclosing a deep sinus with the canine tooth. From the anterior side of this sinus the larger external incisor issues, with its root extensively exposed externally. A rib ascends from the front of its alveolus to the anterior or nareal margin of the bone. The triturating surfaces of the incisors are directed backwards, and the alveolar edge is thickened in front of them with a tuberosity. The teeth are much worn so that the forms of the crowns cannot be determined, but projecting .25 inch beyond the alveoli they are compressed, the large outer tooth with a longitudinal angle in front.

The *mandibular rami* are quite elongate, and indicate a cranium near the size of that of the brown bear (*Ursus arctos*). Their form is slender, and they have a long, rather narrow, symphysis, which projects obliquely forwards. The angle is not preserved. The mental foramen is large and issues just behind the canine teeth.

The *dentition* is I. $\frac{3}{?3}$; C. $\frac{1}{1}$; M. $\frac{?7}{7}$. The canine is of very large size especially the part protruded beyond the alveolus. The crown is stout at the base, but is soon compressed and obliquely truncated by the attrition of the inferior canine, on its inner face. Two superior molars preserved are three-rooted, and the section of the crown is more or less equally trilobate. The number in the maxillary bone is estimated at seven, the number found in the ramus of the mandible. There are six two-rooted molars below and probably one single-rooted premolar, though this is indicated by an alveolus only. The molars are rather narrow antero-posteriorly, and are not very different in size, except that the penultimate is a little longer, and the last a little shorter than the others. There was evidently a longitudinal cutting edge behind, and some other shorter process on the front of the crown; the edge is preserved on the last tooth and resembles that of *Mesonyx*, so that I have little doubt that the remainder of the tooth was, as in that genus, a conic tubercle. The most remarkable feature of the genus is seen in the inferior canines. These are very large teeth, and are directed immediately forwards, as in the case of the cutting teeth of rodents. They work with their extremities against the retrorse crowns of the two external incisors above; and laterally against the superior canine. They are separated by a space about equal to the diameter of one of them. In this space I find no alveoli nor roots of teeth; the outer alveolar wall extends far beyond the inner. The latter terminates opposite the middle of the superior canine. It may be that there are no inferior incisors.

Some of the vertebræ display stout triangular neural spines; on the lumbars the posterior zygapophyses are embraced laterally by the grooved correspondents of the succeeding vertebra. Some of the caudal vertebræ are long, slender and without neural arch, indicating that this genus, like *Mesonyx*, had a long slender tail.

Affinities. Having described the available parts of this form, it remains to consider its place in the zoological system. The structure of the dentition of the upper jaw, with the mode of articulation of the mandible remove it from such orders as *Rodentia* and *Edentata;* the only remaining ones with which it is necessary to compare it are the *Perissodactyla*, *Proboscidia* and *Carnivora*. As many of the diagnostic bones are wanting, it is necessary to rely on collateral and empirical indications of relationship. From tapiroid types the development of the tympanic region distinguishes it. From Proboscidians the slender feet and reduced ulna, as well as the longitudinal crests of the teeth separate it. It then remains to compare it with *Perissodactyles* of the types which possess strong canine teeth. In points of resemblance to these we have the flat claws and separate scaphoid and lunar bones, nevertheless the greater number indicate truer affinity to the *Carnivora*. Such are the external transverse glenoid cavity, the teeth with longitudinal crests, the slender digits, the well developed tympanic bone; confirmatory are the large canine teeth, the incomplete orbit, and the projecting inner condyle of the humerus. The form of the claws is not absolutely incompatible with the same order, as it is approximated by some of the Seals.

Among *Carnivora*, the feet are like both dogs and bears. The very prominent postglenoid ridge, and the narrow tympanic chamber* are decided points of resemblance to the bears, but the *cavum tympani* is even less expanded than in those animals. The characters of dentition are more like those of the *Hyænodontidæ* and *Mesonyx* than any other group, and even the remarkable incisor-like inferior canines are approximated by the anteriorly directed canines of *Hyænodon leptorhynchus*, Laiz. et Par.

As a summary, it may then be concluded that the genus *Synoplotherium* is a Carnivore, presenting a number of points of resemblance to the bears, and to the extinct *Hyænodons;* but that its distinct scaphoid and lunar bones, and flat claws ally it to other forms of *Mammalia*, showing it to be a more generalized type of the order than either of the above. The peculiar approach of the lower canines is a special modification for peculiar habits, which I suspect to have been the devouring of the turtles which so abounded on land and in the waters of the same period. The slender symphysis could most readily be introduced into the shell, while the lateral pressure of the upper canines with the lower, would be well adapted for breaking the bony covering of those reptiles.* It is not unlikely that this genus, *Mesonyx* and possibly *Hyænodon* form part of the lost series which terminated in the Seals of the present.

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* See Prof. Flower's Osteology of Mammalia on this point.

SYNOPLOTHERIUM LANIUS. Cope.

Proceed. Amer. Philos. Soc., 1872, p. 483.

The cranium of this species is rather less than that of the grizzly bear, while the other bones do not indicate so large an animal.

Measurements.

	M.
Length glenoid cavity	0.045
Width " "	.025
Diameter zygomatic fossa	.058
Width opisthotic inside for. stylohyoideum	.014
Diameter meatus auditorius externus	.012
" cavum tympani	.009
Length ramus mandibuli preserved	.228
" of series of seven molar teeth	.131
" last molar, crown	.0155
Width " "	.0080
Length of penultimate "	.0215
Width " "	.0100
Length exposed part of inferior canine	.024
" " superior "	.032
" " outer upper incisor	.023
Diameter triturating surface inferior canine	.028
" do., transverse	.0166
" superior canine (antero-posterior)	.024
" of the two inner incisors	.010
" of exterior incisor (oblique)	.010
" symphysis mandibuli	.044
" nareal orifice	.040
Depth " "	.031
" mandibular ramus at M. 6	.049
Thickness below of do	.014
Length of a superior molar crown	.020
Diameter condyle of humerus	.047
" shaft " (compressed)	.0410
" condyles "	.0415

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* See Proceed. Amer, Philos. Soc. 1872, p. 484.

Measurements.

	M.
Diameter condyles of humerus (antero-posterior)	.032
" head radius (transverse)	.0283
" " " (vertical)	.0163
" shaft radius	.016
" cotylus of ulna (long)	.030
Depth ulna at coronoid process	.034
Length carpus and digit 2 without unguis	.113
" two phalanges do	.037
" metacarpal do	.061
Length metacarpal No. 3	.074
" " No. 4	.070
" " No. 5	.053
" scaphoid transversely	.023
" cuneiform "	.027
" pisiform	.027
Width " distally	.016
Length unciform transversely	.020
Width " antero-posteriorly	.013
" trapezoid "	.0155
" trapezium "	.0114
Length " vertically	.016
Width scaphoid antero-posteriorly	.015
" navicular "	.0155
Length " transversely	.0255
" ungueal phalange	.016
Width " "	.010
Diameter centrum of lumbar vertebra	.029
" " caudal "	.009

The dental series is uninterrupted from the canine if, as I believe, there is an alveolus for a simple premolar behind it. This I overlooked when first describing the species and hence gave the molars as 6 instead of 7. The superior canine is smooth, but the inferior one of the left side has a longitudinal groove on its extero-inferior face.

Restoration. This carnivore had a large head, with a long, rather narrow, and truncate muzzle. The limbs were relatively smaller, not exceeding those of the black bear (*Ursus americanus*), in length and thickness. The tail was long and slender as in the cats, while the claws were broad and flat as in the beaver.

History, Locality, etc. The teeth are very much worn, indicating the hard food on which the animal had subsisted, as well as its mature age.

I originally described this species as resembling the remarkable genus *Anchippodus** of Leidy, and subsequently (on the Short-footed Ungulata of Wyoming, etc., p. 5) have alluded to the large rodent incisor-like teeth as though they were homologous in the two genera. I there identified those teeth in *Synoplotherium* as canines, adding that they were probably the same in *Anchippodus*. Having determined the carnivorous affinities of the former genus, the homology of these apparently similar teeth in the latter becomes problematical. With our present knowledge, the type of molar teeth in *Anchippodus* resembles that of many ungulates, and it is not therefore probably allied to *Synoplotherium*. Nevertheless it is far from certain that the teeth in question are incisors, and that the genera are in nowise related, though a similar modification of a remarkable character in distinct but co-existent types is by no means an unprecedented circumstance.

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* See in Hayden's Geol. Surv. Montana, 1871 (as *Trogosus*).

The remains on which the above identification is based, were found by the writer on a terrace of the Mammoth Buttes near South Bitter Creek in Wyoming. The cranium and fore foot and leg were excavated from the deposit.

Formation, the Bridger Group of the Eocene of Hayden.

Prof. Marsh has described two genera of *Carnivora* from the same formation, embracing species approaching this one in size. They are both distinguished by the broader forms of the crowns of the inferior molar teeth and other points.

Stated Meeting, April 18th, 1873.

Present, 23 members.

Vice-President, Prof. Cresson, in the Chair.

A letter with photograph, was received from Mr. Edmund Quincy, dated Dedham, Mass., April 11th, 1873.

A letter requesting a set of the Society's Proceedings was received from Prof. Frank H. Bradley, of the East Tennessee University, State Agricultural College, Knoxville, dated April 15, 1873. On motion, the University was ordered to be placed on the Correspondents' List, to receive the Proceedings from the beginning.

A letter requesting missing Numbers 83, 84, 85, was received from R. Ketzschen, dated Chemnitz, Jan. 8, 1873; and referred to the Secretaries to act.

A letter proposing exchanges with the Victoria Institute, or Philosophical Society of Great Britain, was received from Mr. F. Petrie, Secretary, dated 8 Adelphi Terrace, Strand, London, W. C., 1st April, 1873. On motion, that Institute was ordered to be placed on the Correspondents' List, to receive Transactions and Proceedings.

Prof. Cope read a paper "On the Osteology of the extinct Tapiroid Hyrachyus."

And another "On the Origin of the Orders of the Mammalia Educabilia."

Mr. Lesley exhibited and described a Micrometer for Office-use by Civil Engineers and Geologists.

Two specimens of old wood carving was exhibited by Prof. Frazer, which he had found lying among the debris of a destroyed temple and village, situated on an artificial (?) mound on the banks of the Rio Pecos, 150 miles above Santa Fe, in New Mexico, known by the traders and Indians as the Ancient Settlement, of which no tradition survives.

Dr. Allen discussed the markings on the specimens and considered them not Aztec, although perhaps manufactured under an influence emanating from the Aztec regime. They resembled the base and top of columns. One showed unmistakable evidence of having been merely a post, for there was an ornament on its flattened top. The tori were rudely cross-barred, and the sunken bands were scored at intervals in one direction by some instrument like an inch gouge, and at a single blow. An iron sharp-edged tool would be necessary to make such a mark. Similar relics have been brought back by Major Powell, whose collection of them is large. The marks on them are similar; and occasionally single Aztec symbols occur. The Indians pretend to comprehend their meaning.

General Kane, who has just returned from a long journey through the Mormon and Southern Indian Regions, objected to the use of the term Aztec as meaningless, believing that no such race ever existed. He alluded to his long residence among the Indian tribes west of the Mississippi River, in 1846, when he first learned to know the caste distinctions in the different nations: the aristocratic part of the tribe being quite distinct from the common part. A third distinction of an enslaved caste also obtains. In his subsequent visits to his old Indian friends, now sadly diminished in numbers, his former views were reinforced by newer observations and conversations with the chiefs and warriors. The Navajo Indians, for instance, hold a part of the tribe in slavery. These slave Indians alone bear burdens. Major Powell was deceived in supposing that his carriers were genuine Navajos. They were Navajo slaves; and his report of his having induced the aristocratic Navajos to tote his luggage was received from the mouth of Gen'l Kane with a good-natured amused derision. He saw the slave of a Navajo Chief with the features of another tribe; yet the slave was born in the Navajo lodges and was called a Navajo.

Gen. Kane stated as a law that when a strong race conquers a weak one it permits the vulgar part of the weak race to survive, enslaves it and incorporates it more or less completely with the aristocratic part of the vanquished tribe. Natural laws aid in this process. The aristocratic female part of a tribe are more exposed to syphilism, and the aristocratic warriors and chiefs more exposed in battle than the common Indians.

Pending nominations from 715 to 735 were read and Nos. 733 and 735 postponed.

The ballot-boxes being scrutinized by the presiding officer the following gentlemen were declared to be duly elected members of the American Philosophical Society:

Sir William Thompson, of England.

Mr. A. R. Wallace, of England.

Mr. Phillip Lutly Sclater, Secretary of the Zoological Society, London.

Sir Henry Thompson, M. D., Professor of Surgery in the University Hospital, London.

M. Edouard Dupont, Director of the R. Museum of Natural History, Brussels.

Baron Selys de Longchamps, of Liège.

M. Theodore M. Gougain, of Bayeaux, Calvados, France.

M. Henri de Saussure, of Geneva.

Sig. Giovanni Capellini, of Bologna.

Sig. Giovanni Battista Rossi, of Rome.

Sig. Prof. Palmieri, of the Observatory on Mt. Vesuvius.

Prof. Heinrich Helmholtz, of the University at Berlin.

Prof. Theodor Mommsen.

Mr. Theodore D. Rand, of Philadelphia.

Prof. Joseph LeConte, of California.

Prof. John LeConte, of California.

Mr. John Fulton, of Saxton, Huntingdon, Co., Pa.

Mr. Lloyd P. Smith, of Philadelphia.

Prof. Geo. F. Barker, of the University of Pennsylvania, in West Philadelphia.

And the meeting was adjourned.

ON THE OSTEOLOGY OF THE EXTINCT TAPIROID HYRACHYUS.

By Prof. E. D. Cope, A. M.

(*Read before the American Philosophical Society, April* 18, 1873.)

This genus was originally described by Leidy[*] from portions of skeletons of individuals from the Eocene tertiary of Wyoming. He recognized it as related to the *Lophiodon* of Cuvier in dentition, and as sharing with characters of that Eocene genus, peculiarities which belong to the existing genus *Tapirus*.

Having obtained a large series of remains of this genus, including more or less numerous portions of six species with nearly complete skeleton of *H. eximius*, Leidy, I propose to give such an account of its osteology as will place its relations on a certain basis.

The characters which distinguish its dentition from those of the allied genera are as follows:

Tapirus, Briss. *Lower jaw*: third molar two-crested; three premolars, the third and fourth with two transverse crests. *Upper jaw:* seven molars, first with an inner heel tubercle; other premolars with two transverse crests.

Hyrachyus, Leidy. *Lower jaw*: third molar with two crests; four premolars, third and fourth with one transverse and one longitudinal crest. *Upper jaw*: seven molars, first without interior heel; premolars with two transverse crests.

Lophiodon, Cuvier. *Lower jaw*: third molar with three cross-crests; premolars three, Nos. 2 and 3 with longitudinal crests. *Upper jaw*: premolars with longitudinal crest only; No. 4 with two transverse crests. *Upper jaw:* premolars with only one transverse crest.

In *Hyrachyus* the nasal bones are elongate, and unite with the maxillaries anterior to the orbit; in *H. eximius* above the foramen infra-orbitale exterius; in *Tapirus* those bones are much shortened, and either do not unite with the maxillaries or join them and the frontals above the orbit at different points from the anterior to the posterior borders. The temporal fossæ are so extended as to produce an elevated sagittal crest, which is bifurcate behind, each projection continuing along the outer margin of the occipital region as a lateral crest. The tympanic bone is unossified beneath the *meatus auditorius externus*, which is bounded in front by a strong postglenoid process. Posteriorly it is bounded by a long descending mastoid process of the squamosal bone, nearly closing it below. This is bounded posteriorly by a long and stout paramastoid process, which is compressed from before backwards and curves backwards and inwards. The foramen magnum has prominent supero-lateral margins which are nearly straight, and unite at a right angle above.

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[*] Hayden's U. S. Geological Survey of Montana, 1871, p. 361.

The dentition is thus: I. $\frac{3}{3}$; C. $\frac{1}{1}$; P.M. $\frac{4}{4}$ M. $\frac{3}{3}$; a considerable diastema separates the premolars and the canine.

In the species studied, the vertebræ are divided as follows: C. 7; D. 18; L. 7; S. 5; C. ?; Of the cervicals the seventh only is not pierced by the arterial canal. The atlas has a broad flat "transverse" process.

The digits are 4—3; the third with a symmetrical hoof, those of the exterior digits halved; the former have two reverted proximal processes, the latter, one. The astragalus exhibits a deeply-grooved and extensive trochlear arc, with rather long neck, which has a greater facet for the astragalus, a lesser for the cuboid bone.

From the above it is evident that this genus is nearly allied to *Tapirus* and cannot be removed to another family. Professor Leidy states that the premolars differ from those of *Tapirus* in having "but one inner lobe connected with the external crest by two transverse crests." The appearance of one lobe is produced by the posterior curvature of the anterior transverse crest round the inner extremity of the posterior crest.

I now proceed to describe the skeleton more exactly.

HYRACHYUS EXIMIUS. Leidy.

Hayden's Geol. Survey, Montana, 1871, p. 361.

Cranium. In the specimen to be described, the anterior portion from the glenoid cavities is wanting. The sagittal crest is quite elevated, and the lateral occipital quite prominent, and continuous below with the superior margin of the squamosal portion of the zygoma. Four nutritious foramina pierce the parietal bone near its middle and above the paramastoid process, and two enter the squamosal above the postglenoid process. The paramastoid process approaches near the occipital condyle by its posterior border. I cannot discover the sutural boundaries of the mastoid bone, but that separating the paramastoid process from the process in front of it is distinct. The condyle of the mandible is massive and the posterior border of the latter extends backwards with a slight obliquity.

Measurements.	M.
Elevation of sagittal crest above foramen magnum	0.045
Width of bifurcation of crest behind	.038
“ occiput behind meatus auditorius	.070
Width between, inclusive of occipital condyles	.046
“ temporal fossa at meatus	.050
“ meatus auditorius	.012
“ condyle of mandible	.032
Depth of ramus behind	.095

In further illustration of the species I add measurements of teeth, etc. from another specimen :

Length of last two superior molars	.041
“ last molar	.019
Width of last “	.022
Length of inferior molar series	.095
“ “ premolars	.040
“ “ last molar	.021
Width “ “	.013
Depth ramus at first true molar	.040

Vertebræ. The atlas is deeply incised anteriorly above. It is rather short and its transverse processes are flat, thin, about as long as broad and with regular convex distal margin. The arterial foramen issues some distance above and within the notch which marks the anterior base of the transverse process. It enters at the notch at the posterior base. The neural arch is quite convex and its anterior margin is obtusely rounded. The axis is near the same length and bears a prominent and elongate laminate neural spine. Its diaparapophysis is narrow and overlaps the parapophysis behind it three-quarters of an inch; it is pierced for the cervical artery. The centra of the third and fourth cervicals are about equal in length to that of the axis, but the remaining ones shorten successively to the seventh which maintains a length somewhat greater than its width. The parapophyses of these, except the seventh, are flattened and have considerable antero-posterior extent, their extremities overlapping. A short and rather narrow and stout diapophysis is present on the sixth cervical; on the seventh it is larger, especially expanded antero-posteriorly at the base, and truncate. There is no parapophysis. The fourth, fifth, sixth and seventh have strongly opisthocœlian centra; that of the third is injured.

Measurements.	M.
Length of the cervical series	0.175
“ atlas, between articular faces	.046
“ base transverse process	.035
“ of “ “	.020
Diameter neural canal in front	.021
“ of anterior expanse	.050
“ “ total “	.099

Measurements.	M.
Length axis along basis neural arch	.021
Elevation crest (rectangular) from posterior zygapophysis	.036
Length parapophysis of fifth cervical on margin	.051
Extent zygapophyses " " "	.048
Expanse " " " " behind.	.044
Elevation neural spine of C. 6	.056
" " " C. 7	.075
Length centrum below " "	.028
Diameter of cup, about	.032

The measurements indicate that the neural spines of the sixth and seventh are quite elevated, the latter nearly equal to that of the first dorsal.

The spines of the dorsal vertebræ are elevated in the front of the series rising some distance above the scapulæ. They shorten and widen rapidly from the middle of the series backwards. The extremities of all from the scapula posteriorly are turned forwards. The metapophyses are conspicuously elevated above the diapophysis on the eleventh dorsal, and on the eighteenth, their elevation is about .4 that of the neural spine. The diapophysis is extended beyond the tubercular articulation, on the 18th dorsal; the extension and expansion increases rapidly on the lumbars. On the fourth they are as wide at the base as .66 the length of the centrum and maintain their width, being directed anteriorly. On the sixth and seventh they are still wider and longer, and very thin. They present a projecting transverse surface backwards one-fourth the length from the base for articulation with the seventh lumbar and first sacral respectively. The centra of the lumbars are depressed and slightly opisthocœlian, except the last, which is flat. They are contracted and keeled below.

The sacrum is long and narrow, and thoroughly coössified in the specimen. The diapophysis of the first and part of that of the second gives attachment to the ilium. The intervertebral foramina are rather small.

Measurements.	M.
Length of dorsal vertebræ along middles of neural spines	.420
" of lumbars do.	.298
" of sacrum along centra	.170
Diameter centrum first dorsal (transverse)	.019
" " " (vertical)	.019
" " fifth lumbar "	.020
" " " (transverse)	.0325
Length do.	.039
" diapophysis sixth do.	.065
Greatest transverse width of diapophysis sixth lumbar.	.030
Length centrum seventh lumbar	.034

Measurements.	M.
Transverse diameter centrum first sacral	.036
" expanse diapophyses do.	.086
" diameter end of last sacral	.020
" " diapophyses do.	.043
Elevation neural spine second dorsal	.095
" " seventh " above scapula	.035
" " eighteenth " (from arch behind)	.087

The *ribs* are long and slender, the first but little expanded distally ar united with the *manubrium sterni* a little behind its middle. They nu ber eighteen, but as the last is quite long, there may have been anoth pair of shorter ones not yet exposed in the matrix.

Measurements.	M.
Length first	0.118
Width first, distally	.018
Length eighteenth } from tubercle.	.180
" sixteenth (end broken). } from tubercle.	.223

There are four *sternal segments* preserved, with a fragment of another. They are distinct, and the first is the largest. It is a longitudinal plate, placed on edge, with the anterior border strongly excavated. The inferior margins of the succeeding segments are thickened, but the compressed form remains, the section being triangular.

The *scapula* is large for the size of the animal. It has an approximately triangular form, the base being superior. The posterior angle is right, but the anterior regularly rounded. The apex supports the glenoid cavity on a neck which is contracted by a shallow excavation of the anterior margin. The latter is bounded next the glenoid cavity by the short obtuse coracoid, which stands a short distance above the articulation. The spine is long, rather elevated, with a regular convex border curved backwards.

Measurements.	M.
Length of three sternal segments	0.147
" first " "	.084
Depth of " " " in front	.044
Width of " " " below	.004
" third " "	.015
Length of scapula (median)	.215
Width above (greatest)	.180
" of neck	.036
" of glenoid cavity	.035

Humerus. The head is directed a little inside of directly backwards. The bicipital groove is very deep and the inner tuberosity large and directed forwards. The external tuberosity is much larger, as usual in this group of ungulates, and rises in a hook-like apex above the level of the head. The external bicipital ridge is lateral, and not very prominent, extending on one-third the length of the shaft. The shaft is moderately compressed at the middle, but transversely flattened below. It is nearly straight. The condyles are narrow, and the inner and outer tuberosities almost wanting; their position marked by shallow concavities. The external continues in a lateral crest which turns into the shaft below the lower third. The inner condyle is both the widest and most prominent; the external has its carina at its middle, and its external trochlear face oblique and narrow; narrowest behind. The olecranar and coronoid fossæ are deep and produce a small supra-condylar foramen.

The *ulna* exhibits a large and obtuse olecranon, concave on the external face. Its glenoid cavity is narrowed and elevated behind; in front it widens, and there the ulna receives the transverse proximal end of the radius, which overhangs it on both sides, leaving the little elevations of the right and left coronoid processes about equal. The vertical diameters of the shaft of the ulna are about equal throughout. Its section is triangular, the base being next the radius for the proximal third. This is followed by an edge next the ulna, and the base of the section is on the outer inferior aspect, an account of the direction of an angle from a short distance beyond the outer coronoid process to the base of the ulnar epiphysis, where it disappears. Distally there are two other very obtuse ridges above this one. The extremity bears two facets, the larger for the cuneiform, the smaller for the pisiform bone.

The *radius* is throughout its length a stouter bone than the ulna and bears much the greater part of the carpal articulation, viz.: with the scaphoid, lunar and part of the cuneiform bones. This articulation is transverse to that of the ulna, which is thus at one side of and behind it. The head is a transverse oval in section, the narrower end outwards. The articular face consists of one-and-a-half trochleæ, the latter wider and internal. The shaft is a transverse oval in section, with an angular ridge along the middle externally, and the distal part proximally. A broad groove marks the upper face of the epiphysis, where the shaft has a vertical inner face.

Measurements.	M.
Length humerus (axial)	0.270
Diameter head to bicipital groove	.037
Length along crest outer tuberosity (about)	.052
Transverse diameter, distally	.046
Antero-posterior do. inner condyle	.042
Width olecranar fossa	.020
Length ulna	.260
Depth olecranon, distally	.027
" at coronoid process	.025
" of distal end	.019
" at middle shaft	.019
Length radius	.200
Width of head	.036

Depth of head	.021
Width shaft at middle	.021
" near distal end (greatest)	.037
" distal articulation	.030

The elements of the *carpus* are distinguished for length, and for reduction of width. The anterior faces of all are considerably longer than broad, but the longest faces of the cuneiform, scaphoid, and trapezoides are antero-posterior. The facets are as usual in the carpus; scaphoid $\frac{1}{3}$; lunar $\frac{1}{2}$; cuneiform $\frac{2}{1}$; trapezium $\frac{1}{1}$; trapezoides $\frac{1}{1}$; magnum $\frac{2}{3}$; unciform $\frac{2}{1}$. The cuneiform has a rather L-shaped external face. The pisiform has two proximal facets and is enlarged and thickened distally; pressed inwards it reaches the scaphoid. The trapezium is a small subdiscoid bone with convex outer face. The magnum is as broad as deep in front, where its surface is swollen; it is produced behind into a spatulate decurved hook. The unciform has a narrow sub-acute hook behind, with wide base.

Measurements.	M.
Width of carpals of first row together	0.044
" of lunare, outer face	.016
Depth " "	.020
" cuneiform "	.020
Width " "	.020
Length pisiform "	.030
Depth distally "	.014
Width three carpals of second row	.038
" magnum outer face	.015
Depth " "	.014
" unciform "	.017
Width " "	.020
Length " antero-posterior	.021
" magnum "	.029
Total length of carpals	.040

The *metacarpals* are quite slender. The first only is wanting; the third is rather stouter than the others, while the fourth is considerably the most slender. Its distal extremity is oblique with prominent median keel, which is wanting on the superior aspect. The proximal facets of these bones are respectively (2d) 2, (3d) 2, (4th) 1, (5th) 1. There is a short shallow groove near the proximal front of No. 3. The phalanges corresponding are lost in the specimen.

Measurements.	M.
Length of fifth metacarpal	0.070
Estimated length of foot	.187
Distal diameter of 5th metacarpal	.012
Proximal " "	.007
" " 4th "	.012
" " 3d "	.017
" " 2d "	.012

The above are taken on the articular faces transversely.

The *pelvis* is perfectly preserved. The ischium is but little over half as long as the ilium measuring from the middle of the acetabulum. The ilium is a triradiate bone, the superior or sacral plate rather shorter and wider than that forming the "crest," which is subsimilar to the peduncular portion. The crest expands very slightly distally forwards and downwards. The ischio-pubic suture is a long one, and the obturator foramen a long oval; the inferior pelvic elements do not form a transverse, but meet at an open angle.

Measurements.	M.
Length ilium to sacral border	0.130
" " " crest	.180
" crest	.060
Width peduncle	.030
Length ischium from middle of acetabulum	.110
Width do. posteriorly	.080
Length obturator foramen	.041
Width " "	.034
Expanse of ischia above at middle	.076

Femur. The head projects inwards on a well-marked neck. The great trochanter is strongly recurved and presents an anterior tuberosity as well. It rises to an incurved apex much elevated above the head. The prominence of the front of the femur is continued into the front of the trochanter. The outer margin of the shaft is thin, and at a point two-fifths the length from the proximal end is produced into a low thin trochanter, which is curved forwards and thickened on the margin. The trochlea is well elevated, the inner margin a little the most so, and is narrow. It is continuous with the surface of the inner condyle, which is the shorter and more vertical; the external is longer and divergent; its terminal face is marked by two fossæ, one in front of the other just outside the distal end of the ridge bordering the trochlea. Little trochanter moderate.

Measurements.	M.
Total length	0.285
Proximal width of head and trochanter	.075
Width from front to edge third trochanter	.050
" just above condyles	.035
" of condyles	.058
Chord of outer condyle and trochlea	·060

The *tibia* has a broad prominent crest, which is remarkable in being deeply fissured longitudinally at its superior portion. The tendinous notch separates the outer portion of the crest from the spreading margin of the outer cotyloid face. The crest disappears at the proximal third, and the shaft becomes flattened in front and on the inner side. The distal articular extremity is impressed by 1.$\frac{2}{3}$ trochleæ, the outer being completed by the fibula. The posterior tuberosity is more nearly median than usual, hence the inner margin of the inner trochlea is low posteriorly, and the inner malleolus has a considerable beveled inferior margin. The *fibula* has a slender shaft, but little compressed. The head is expanded fore and aft, and the malleolus is quite stout.

Measurements.	M.
Length of tibia	0.244
Diameter from outer angle of head to inner angle of crest	.065
Diameter distal end (greatest)	.035
Diameter articular face, transverse	.027
" " " fore and aft	.026

Both *hind feet* are perfectly preserved. The calcaneum is rather elongate and compressed, the lower face truncate with two longitudinal bounding ridges, the outer of which is discontinued before reaching the heel. The surface between them is striate grooved. The outer face is slightly concave. The astragaline facets are much expanded inwards; the outer is transverse and strongly convex, and separated by a groove from the inner, which is longitudinal and nearly plane. The posterior edge of this, and convexity of the outer facets are received into a transverse groove of the posterior part of the lower face of the astragalus. The cuboid facet is diagonal and is bounded within by a third narrow facet for the astragalus. The astragalus has a strongly convex deeply grooved trochlea; the convexity extends over 158°. The trochlea is nearly in the vertical, a little oblique to the longitudinal axis of the foot. The exterior malleolar facet is well marked and bounds a lateral fossa above. The neck of the astragalus is broad and not contracted, but not wider than the trochlea. Its navicular facet is wide and concave, the cuboid narrow, with a long angle behind. The cuboid is quite elongate and with a narrow anterior face; it has a large posterior tuberosity not projecting much posteriorly. The navicular is flat with a sigmoid proximal face, convex on the inner side, concave on the outer. It has the three cuneiform facets below, the inner antero-posterior. The inner is a flat bone with antero-posterior plane, and apex directed backwards, and considerable oblique facet for the second metatarsal. The mesocuneiform is much the smaller and brings the third metatarsus a short distance proximal to the fourth. The ectocuneiform is a little wider than deep. The metatarsals are three, and are rather slender. The two outer are equal in length, and the median but little wider proximally, the increased width being more obvious distally. They have no proximal grooves, and the outer has a low outer tuberosity. The facets of the second row of tarsals are $\frac{1}{1}$ $\frac{1}{1}$ $\frac{1}{1}$. The phalanges, including ungueal, are 3, 3, 3. The proximal ones are longer than wide and contracted at the ends; the penultimate are still stouter in form. The ungues of the middle line are symmetrical and broad, with the margin a segment of an ovoid, and slight contraction at the neck. The proximal articulation is bounded by a fossa on each side, which is in its turn, isolated by the elongate process found in the tapir and in the horse. The margin is marked by radiating striæ separated by grooves, of which the median is the most marked. The lateral ungues are contracted on the inner side, and only possess the proximal fossa and hook on the outer side. The median distal groove is well marked.

Measurements.	M.
Length of hind foot from heel	0.286
“ calcaneum	.083
“ cuboid facet of do.	.024
Depth calcaneum behind	.025
Width “ at astragalus	.035
Greatest axial length of “	.045
Width between trochlear crests do.	.022
Length neck do. outer side	.014
Width head do.	.030
“ navicular	.031
Length “ at middle	.010
“ cuboid	.022
Depth “ outside	.025
Length ectocuneiform in front	.013
Width “ “	.019
“ mesocuneiform “	.019
Length “ “	.008
“ entocuneiform at side	.021
Depth “ “	.015
Length of metatarsus II	.102
“ “ III	.107
Width “ II. proximally	.016
“ “ III. “	.020
“ “ II. distally within fossa.	.016
“ “ III. “ within fossa.	.025
Length median phalanges I	.025
Width “ “ distally	.015
Depth “ “ “	.009
Length “ “ II	.015
“ “ “ unguis	.029
Width of articular facet do	.014
“ neck of do	.021
“ greatest expanse do	.029
Length phalanges of metatarsal II	.060
“ unguis “ “	.028
Width “ (greatest)	.018
Length metarsus and phalanges IV	.158

Restoration. The following dimensions may be relied on as a basis for a restoration of this species:

		M.
Length	head	0.220
	vertebral column less tail	1.063
	equal 42.1 inches	1.283
Height	of neural spines exposed	.035
	of scapula	.215
	of fore leg	.697
	Total 31.05 inclusive	.947
Height	of hind leg	.770
	of elevation of ilium	.135
	Total 29.7 inches	.905
Depth of body at middle manubrium		.255
" " at 15th rib		.250

Allowance being made for the obliquity of the humerus, scapula, femur and ilium, the elevation in life was,

	M.
At the withers (26.6 inch)	.872
" rump	.762

The size of this species was then that of a large sheep.

Comparison of the skeleton with that of Tapirus roulini. For the opportunity of making this comparison I am indebted to the Smithsonian Institution, which possesses a skeleton of the above species of tapir from Equador, presented by President Moreno.

Cranium. In addition to the generic characters mentioned at the commencement of this description, the *H. eximius* and *T. roulini*, differ as follows: in *H. eximius* there is (1) a high sagittal crest which is wanting in *T. roulini*, *T. malayanus*, and approximated in *T. terrestris*. (2) The crest of the squamosal part of the zygoma is continuous with the lateral occipital crest, which is not the case in existing tapirs.

Vertebræ. (1) The arterial canal of the atlas is not isolated in front as in *T. roulini*, but notches the basis of transverse process. (2) The axis is longer than in *T. roulini*. (3) The neural spines and especially the metapophyses of the posterior dorsal vertebræ are more elevated. (4) The ends of the centra of the lumbars are flatter, and more depressed. (5) The diapophyses are wider and longer and thinner and the penultimate articulates with the last by an angular process, which is not the case in *T. roulini*.

Scapula. (1) This bone is equal in size to that of a *T. roulini* of considerably greater general dimensions, and is hence relatively larger. (2) The spine is not angulate as in that species, has a longer base, and longer elevated margin. (3) The neck is more contracted and (4) the coracoid is not recurved as in *T. roulini*. (5) The sinus bounded below by the latter is much shallower, and not bordered above by a recurved hook of the margin

Humerus. (1) It is relatively smaller in *H. eximius.* (2) The internal bicipital ridge of *T. roulini* is wanting. (3) The external condyle is much shorter, whence its border is nearer its trochlear rib. The *radius* has a narrower head (1), the external articular plane being shortened. (2) The shaft is wider with a more acute longitudinal lateral ridge medially, and more rounded distal end. The *ulna* is (1) absolutely nearly as long as in *T. roulini*, being thus relatively longer. (2) It has three weak longitudinal ridges on a convex outer face; in *T. roulini* the external face is divided by a very prominent longitudinal angle from the radial cotylus, which spreads distally, sending one angle to the upper and another to the lower base of the distal epiphysis.

Carpus. This part is (1) absolutely and relatively smaller than in *T. roulini.* (2) The pisiform is more cylindroid distally. (3) The scaphoid is more produced backwards on the inner side; the excavation of the inner side is more continued as a concavity of the outer side of the front. (3) The unciform has an acute tuberosity behind; in *T. roulini* it is short, vertical and obtuse. (4) The trapezoides has a shorter, wider, and more swollen external face. (5) The pisiform is small and convex instead of being larger and flat.

The *metacarpals* (1) are absolutely and relatively smaller. (2) The inner (II) has a more oblique phalangeal articulation, which is short above and with the keel prolonged upwards instead of being as in *T. roulini*, distal only.

The *pelvis* is distinguished by the much longer plate of the ilium, whose extremity constitutes the crest. (1) The crest is also shorter, and more anterior. In *T. roulini*, this plate does not so much exceed the sacral plate. (2) The pubes and ilia are not so horizontal, but meet at nearly a right angle, and (3) the ischiopubic common suture is considerably longer. (4) The obturator foramen is a more elongate oval.

The *femur* is very similar to that of *T. roulini*, being no smaller in relative size. (1) The great trochanter is wider fore and aft, and with margin more continued on the anterior aspect of the extremity of the shaft. (2) The great trochanter is nearer the middle of the length. (3) The condyle surfaces are continuous with the rotular, not isolated as in *T. roulini.* The latter also (4) lacks the two fossæ on the outer margin of the external seen in *H. eximius.* (5) The rotular groove is also narrower in the latter and not so deeply excavated as in *T. roulini.*

The *tibia* is (1) reduced in size, and especially contracted distally; the relative widths of the ends are 6 cm : 3.5; in *T. roulini* 7.5 cm to 5. (2) The crest is more prominent and is deeply fissured by a groove, which is represented by a shallow concavity in *T. roulini.* The groove (3) external to this is deeper. (4) The posterior inner tuberosity of the distal end, is more median, hence the inner trochlear groove is further removed from the anterior inner malleolus, which has, therefore, a greater inner (not outer) extent.

The *tarsus* (1) is generally longer and narrower, except in the case of the cuboid bone (2) which is shorter than in *T. roulini*. (3) The astragalus has a narrower neck which therefore appears more on the inner side. (4) The facet for the cuboid is smaller. (5) The inner tuberosity of the head is more prominent. (6) The calcaneum is more slender, with larger cuboid facet, especially posteriorly. The *metatarsus* is absolutely nearly as long as in *T. roulini*, and therefore relatively longer and more slender. (2) The median (III) is nearly similar to the others in width; in the *T. roulini*, much larger than the lateral.

The *phalanges* of the first cross series are more contracted distally.

The more important differences between the skeletons of the two species in addition to those pointed out under the head of the genus, are those of the ulna, the scapula, the lumbar vertebræ, the ilium and the crest of the tibia. The scapula is more like that of *Tapirus terrestris*, while the ilium is approximated by that of *T. malayanus* among living species; its form leans towards the Equine series, and not to the *Palæotheroid*.

Conclusion. From the preceding it is evident that there lived in North America during the Eocene period, a type of *Tapiridæ* only differing generically from that now existing in South America. Thus one form of the many peculiar and primitive ones of that time still persists in the Tropics and Southern hemisphere, which claims more ancient character than the Rhinocerus, Elephants, and other remains of Miocene time.

The affinities of *Cercoleptes* and *Nasua* to the types of the same period have been already indicated,* and with the present case may be regarded as confirmatory of the proposition stating the early geologic state of the existing *Fauna Neotropica*.

At the Stated Meeting of the Society, June 20, 1873, Professor Cope asked and obtained permission to withdraw his paper on the Primitive Types of the Orders of Mammalia Educabilia.

The current number of the Proceedings having been printed and ready for distribution, the register of the following pages is left as originally printed.

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* See on the Primitive types of the Mammalian Orders, 1873. See Origin of Genera, p. [illegible] and preced.

DESCRIPTION OF LESLEY'S MICROMETER FOR FIELD-NOTE PLOTTING.

(*Read before the American Philosophical Society, April* 18, 1873.)

I desire to place on record in the Proceedings of the Society a description of my Micrometer for plotting field-notes, which appears to be coming into favor with Civil and Mining Engineers.

It was many years ago that the need of such a little instrument forced itself on my attention, as a substitute for a vernier attachment to a scale for use on the office-table. The strain upon the eyes in constant plotting on small scales, say on the common scale of 1000 feet to the inch, or the not uncommon one of 2000, is greater than the best human organs of vision can endure without permanent injury; to say nothing of the loss of time involved in adjusting the dividers, or applying the paper edge, if a paper scale be used directly. Every field worker who has constructed elaborate contour line maps covering an extensive region of country will bear me out in this assertion.

Considering also the liability to error in counting the decimals and hundredths or thousandths of the scale-unit of *distances*, after hours of application to work has lowered the tone of the nervous system, I sought some mechanical substitute analogous to Mr. Cleaver's Protractor, now in almost universal use for plotting *courses* with ease and precision.

Many forms of such an instrument passed through my mind; but over occupation, or perhaps laziness, prevented me from taking the necessary steps to realize the idea in even tentative forms, although I spoke of it several times to Mr. Young, the accomplished and experienced instrument-maker of Philadelphia, now dead.

During my wanderings in Europe in search of health in 1866, '67 and '68, I was several times the guest of my old friend and fellow-laborer in the Anthracite coalfields (1853), Prof. Edouard Desor, at his charming residences on the Combe Varin and in Neufchâtel, Switzerland. One day we strolled into the well-known philosophical instrument manufactory of Mr. Hipp, to whom, among other things, I mentioned the need of a Micrometer Divider for plotting, and drew at his request three of its possible forms, such as seemed to me the most feasible, giving him an order for one, and leaving him to select the form he preferred.

On my return to Philadelphia in the spring of 1868 I received it in a broken condition. The chain had been snapped by some custom-house official, too curious to learn its nature to treat it with much delicacy of handling. It was however easily repaired, and I found it all I could desire: handy, accurate in its action, and perfectly relieving the eyes from the strain of measuring. It was much admired by my professional acquaintances, but remained a solitary specimen until Mr. Kerr, State Geologist of North Carolina, begged permission to have it copied at Mr. Young's (Jr.) establishment. This was in the winter of 1871, '72. I have since been informed by Mr. Kerr that his order was never filled; at least he never received his Micrometer. The original was in constant use by one of my assistants in my office throughout the spring and summer of 1872. When the course of instruction in the new Department of Science of the University of Pennsylvania commenced last fall I accustomed my special geological students to use this instrument among others, and ordered of Heller & Brightly, instrument-makers, a duplicate of it, set however not to centimeters and millimeters, but to inches and hundredths of an inch. While making it, Mr. Eckley Coxe and other civil and mining engineers saw it, and ordered others like it for their own use, and these orders have become so numerous that it has evidently taken its place among the accepted apparatus of the engineer's office-table. I hope many will in future enjoy the relief and comfort from it which I have enjoyed since 1868.

I was urged to patent it, as Mr. Cleaver patented his Protractor. But I feel a natural prejudice against patenting a little thing which may become to some extent a public benefit, at all events within the not altogether narrow limits of one of the scientific professions. I desire, however, to prevent any one else from hampering its progress by a patent, and to that end beg leave to place this record of its invention among the Proceedings of this Society. Any one can obtain the instrument free of patent royalty, from the makers above named, or may order it made for themselues anywhere else.

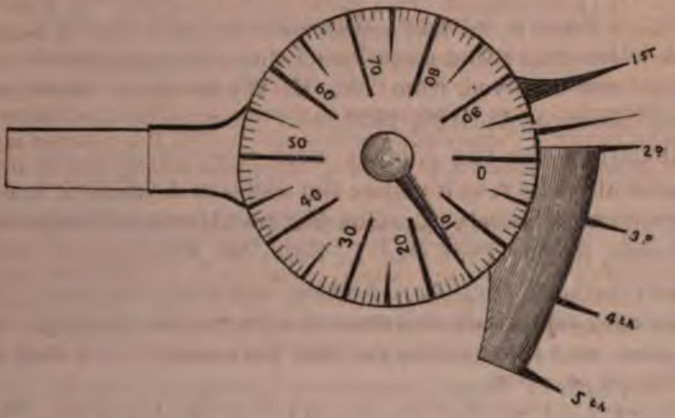
This Micrometer consists of an arc set with three, four or more needle-points fixed at intervals of one centimeter, one-half inch, or any other unit adopted for the survey, equivalent say to 100 feet (yards, links, rods, &c).

A handle projects upward from the inside of the arc by which to hold it, and by which it may be applied to the line of course and be gently rotated, so that each needle-point in its turn pricks its (100 feet) unit distance along the line.

Between the last two needle-points floats a supernumerary needle-point or compass-leg, jointed high up on the handle, and swung or floated to and fro by a simple ratchet and watch chain, turned at will by means of a button, projecting from the centre of a circular disc on the handle; the disc circle being divided into hundredths (thousandths, &c.,) and traversed by an index which starts from and comes round to a stop at zero.

While the index travels over the disc from 0 to 100 the supernumerary needle-point travels from needle-point to needle-point, one unit.

Example of use: Suppose a distance 327 feet to be laid off on a course; the fifth needle is applied to the station (point of tangent, or point of curve) and the arc rotated, so that the fourth needle pricks 100, the third 200, the second 300 feet. Then, the index being brought to 27, the floating needle pricks 327. See woodcut, Fig.



Mr. Eckley Coxe has had a useful addition made to his instruments in the shape of a set of removable rings, divided for 100ths, 1000ths, 66ths, 33rds, &c., &c. Two little screws hold the ring in place, whichever one may be in request for any particular plotting. When plotting on the scale of some other unit of distance is required another ring is substituted.

Stated Meeting, May 2d, 1873.

Present, 14 members.

Prof. CHASE in the Chair.

Letters accepting membership in the Society were received from Henry W. Acland, dated Radcliffe Library Museum, Oxford, England, April 10th, 1873; James Ed. Oliver, dated Cornell University, Ithaca, N. Y., April 21, 1873; John Fulton, dated Saxton, Bedford Co., Pa., April 21, 1873, and Theo. D. Rand, dated 17 South Third Street, Philad'a, May 1, 1873.

Letters of Envoy were received from the Physical Observatory, St. Petersburg, March, 1873; the Austrian Geographical Society, Vienna, Jan. 3, 1873; Prof. G. L. Vose, per S.

W. Blunt, Boston, April 30, 1873; the U. S. Naval Observatory, Washington, Jan. 31, 1873; the Minnesota Academy of Natural Sciences, Minneapolis, April 15, 1873.

A letter requesting donations for the Chicago Public Library was received from W. B. Wickersham, Secretary, dated Chicago, April 28, 1873.

Donations for the Library were received from the Geographical Society, at Vienna; the Belgian Academy; the R. Astronomical Society; London Nature; Revue Politique; M. Sillorata, Rome; Prof. Geo. L. Vose; Mr. Ezra Seaman, of N. Y.; Prof. A. M. Meyer, of Stevens Institute; the Journal of Pharmacy and Medical News; the U. S. Coast Survey; Dr. Hayden, and the Academy at San Francisco.

The death of Baron Justus von Liebig, at Munich, April 18, 1873, aged 70, was announced by the Secretary.

The death of Prof. F. C. Zantedeschi, at Padua, March 30, 1873, aged 76, was announced by letter.

The death of William Sullivant, at Columbus, O., April 30, 1873, aged 70, was announced by the Secretary.

Dr. LeConte in behalf of the Secretaries, exhibited a copy of a paper by Prof. Cope, read at the meeting of April 4, bearing the date March 8, 1873 printed at the end. Prof. Cope made explanations to justify his publication of that date.

Mr. Chase communicated three notes: 1. On Solar rotation; 2. On correlations of Planetary Masses; 3. On Intra-Mercurial Planets.

Mr. Cope, after some introductory observations, requested that the Society authorize the drawing and printing of two plates 8° to illustrate a paper on Flat Clawed Carnivora of the Eocene of Wyoming, the cost for drawing each plate not to exceed thirty dollars.

After discussion by Dr. Le Conte and Gen'l Stokes the motion was seconded and on motion of Mr. Smith postponed to the next meeting.

And the Society was adjourned.

COSMICAL AND MOLECULAR HARMONIES, NO. II.

By Pliny Earle Chase,

Professor of Physics in Haverford College.

(Read before the American Philosophical Society, May 2 and 16, 1873.)

I. Harmonic Indications of Intra-Mercurial Planets.

The modification of the planetary harmonic series, by the inertia of large planetary masses, is perhaps, no less interesting than the primitive series themselves.

If we take the Neptunian radius vector as our unit, the linear centre of oscillation as our prime determinant, and the oscillatory ratio, 3, as our harmonic difference, we obtain the harmonic series,

$$♆ \quad \tfrac{2}{3} \quad \tfrac{2}{6} \quad \tfrac{2}{9} \quad \tfrac{2}{12}, \text{ \&c.}$$

The first term of this series represents the secular mean aphelion of Uranus; the second, Saturn's mean aphelion; the third, Saturn's aphelion centre of linear oscillation, as well as the mean centre of gravity of the planetary system; the fourth, Jupiter's mean perihelion. Jupiter's mean perihelion is at the octave node of Saturn's mean aphelion, and their joint harmonic importance has been amply illustrated in my previous papers.

The regularity of this series is interrupted by the influence of the great masses of Saturn and Jupiter, and although inferior planetary positions may be approximately represented by subsequent terms, they are found only at every eighth term of the Neptunian, or at every term of the simple Jupiter series.

$$\begin{array}{lccccccccc} & ♃ & \tfrac{1}{1} & \tfrac{1}{3} & \tfrac{1}{5} & \tfrac{1}{7} & \tfrac{1}{9} & \tfrac{1}{11} & \tfrac{1}{13} & \tfrac{1}{15} \\ \text{or,} & ♆ & \tfrac{2}{12} & \tfrac{2}{36} & \tfrac{2}{60} & \tfrac{2}{84} & \tfrac{2}{108} & \tfrac{2}{132} & \tfrac{2}{156} & \tfrac{2}{180} \end{array}$$

These terms represent, in regular succession, Jupiter's mean perihelion; the mean aphelion of Mars; the mean distances of Earth and Venus; the mean octave node of Venus and Mercury; Mercury's mean aphelion; Mercury's mean distance; and the Earth's reverse centre of linear oscillation.

The complete continuity of this series, like that of the foregoing, is broken by the combined disturbance of Earth and Venus, but its thirteenth term ($\tfrac{1}{25}$ ♃ or $\tfrac{2}{300}$ ♆) approximates quite nearly to Kirkwood's estimated mean distance of Vulcan (.209 ⊕). A still closer accordance is afforded by the following harmonic series, which assumes Earth's mean distance as the unit.

$$\oplus \quad \tfrac{7}{2} \quad \tfrac{7}{10} \quad \tfrac{7}{18} \quad \tfrac{7}{26} \quad \tfrac{7}{34}$$

The first term of this series represents Jupiter's linear centre of oscillation, at which the planetary masses would balance the Sun, with a centre of gravity at the Sun's surface, which is the source of its radiant undulation; the second, the mean distance of Venus; the third, Mercury's mean distance; the fourth, a possible unknown planet, planetoid group, or other seat of solar and planetary perturbation, with a period of 53.54 ± days; the fifth, a planet with a period of 34.25 days, Kirkwood's estimated period being 34.92 days.

It is especially noticeable that in these three harmonic series, embracing sixteen terms in all, only one appears to be destitute of an obvious planetary representative. The lack of actual known planets at some of the principal centres of linear oscillation, may, perhaps, be accounted for by the action of masses, which, though not sufficient to introduce new series, may have concurred in breaking up the tendency to nodal aggregation. It is possible that future observations may show a somewhat analogous action between Mercury and Vulcan. I am, however, inclined to believe that improvements in astronomical instruments will, at some day, enable careful observers to detect some form of actual material concentration, at $\frac{3}{8}$ Ψ, $\frac{1}{6}$ ♃, $\frac{3}{5}$ ♃, and $\frac{7}{26}$ ⊕.

These harmonic pointings to intra-Mercurial planets are corroborated by the π series of planetary pairs, which was given in my communication of the 4th *ultimo*. The division of Mercury's perihelion distance by π brings us to a point considerably within the limits of the solar retardation, which, if the æther is material, would interfere with any permanent orbital revolution, bringing any planetary masses more or less rapidly to the Sun. There is, however, a certain portion of the region in which planetary stability would be possible, and analogy would lead us to look for a pair of mutually balancing planets, wherever the conditions are favorable for one. The closeness of the harmonic accordance in the position which Kirkwood has assigned to Vulcan, seems to me a strong confirmation of his views, and an equally strong indication of the importance of making special observations in the portion of the Zodiacal belt which is embraced between the orbits of Vulcan and Mercury. If Wolf's supposed Sun-spot period of twenty-seven days* is a sidereal period, it might be readily explained by the perturbations and transits of a planetoid or meteoric group, at a distance which would complete the terrestrial harmonic series. If the proper balancing of orbital undulations requires any extra Neptunian planets, we may, perhaps, have reason to look for some analogy between them and the intra-Mercurial pair, which may complete the symmetry between the outer and inner planetary limits to which I have invited attention in my modification of Bode's Law.

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* Cited by Kirkwood, *ante*, xi. 97.

The following table exhibits the theoretical and observed values for each of the forgoing series :

HARMONIC NODES IN THE SOLAR SYSTEM.

♆ Series.	♃ Series.	⊕ Series.	Theoretical.	Observed.	
$\frac{2}{3}$			20.025	20.048	♅ *a** — ♆ *c. o.*
$\frac{2}{6}$			10.012	10.000	♄ *a*
$\frac{2}{9}$			6.675	6.667	♄ *c. o.* — ½ ♅ *c. o.*
$\frac{2}{12}$	$\frac{1}{1}$		5.006	4.978	♃ *p**
$\frac{2}{36}$	$\frac{1}{3}$		1.669	1.644	♂ *a*
$\frac{2}{60}$	$\frac{1}{5}$		1.001	1.000	⊕
$\frac{2}{84}$	$\frac{1}{7}$		.715	.723	♀
$\frac{2}{108}$	$\frac{1}{9}$		.556	.555	♀ ☿
$\frac{2}{132}$	$\frac{1}{11}$		.455	.455	☿ *a*
$\frac{2}{156}$	$\frac{1}{13}$		.385	.387	☿
$\frac{2}{180}$	$\frac{1}{15}$		.334	.333	⊕ *r. c. o.*
	$\frac{7}{10}$	$\frac{7}{2}$	3.500	3.469	♃ *c. o.*
	$\frac{7}{50}$	$\frac{7}{10}$	.700	.723	♀
	$\frac{7}{90}$	$\frac{7}{18}$	.389	·387	☿
	$\frac{7}{130}$	$\frac{7}{26}$	.269	.269?	(?)
	$\frac{7}{170}$	$\frac{7}{34}$	.206	.209	Vulcan.
Sum......................			51.897	51.842	

II. CORRELATIONS OF PLANETARY MASS.

The Sun's surface, which is the seat of the mutual action and reaction of its attractive and radiating forces, is also the fulcrum of a lever which would balance the solar and planetary masses if the latter were placed near the outer asteroidal limit, or near the linear centre of oscillation of Jupiter's radius vector. The outer end of the lever is also at a distance (3.513 ⊕), at which the velocity of revolution is equivalent to the velocity which would give Jupiter, at its perihelion, a parabolic orbit. These harmonies seem to point to harmonies of mass, which, by means of commensurate momenta or moments of inertia, may help to sustain the equipoise of the system.

I have already pointed out, in my note on "Oscillatory Forces in the Solar System" (*ante, p.* 140), some striking, and, I believe, entirely novel evidences of such harmony, which seem to be attributable to the same play of elastic forces which has assigned to each planet its appropriate position. There are still further and somewhat analogous relations between the centres of gravity of the two principal pairs of planets, as well as between solar and important planetary positions, which I submit as additional confirmation of the influence of æthereal vibration.

My hypothetical arrangement of æthereal particles (*ante*, xii, 408), suggests a primary planetary ellipse in which the transverse is to the conjugate axis in the proportion of 2 to $\sqrt{3}$. In such an ellipse the two foci and either extremity of the transverse axis represent the extremes and centre of oscillation of a linear pendulum; parallels to the lines joining the foci to either end of the conjugate axis, trisect the quadrant and semicircle; the virtual velocity of oscillation at the end of the supposed rigid transverse axis, is to the velocity at the end of the conjugate axis, as the velocity of infinite fall to the extremity of the transverse axis is to the velocity of revolution at its linear centre of oscillation.

**a* — Aphelion; *p* — Perihelion.

Let A and D represent the ends of the transverse axis, B and C the foci of the hypothetical ellipse. Let a denote planetary aphelion; p, perihelion; m, centre of gravity, at secular mean conjunction, of Neptune and Uranus; n, mean conjunctive centre of gravity of Jupiter and Saturn at Jupiter's mean aphelion and Saturn's mean perihelion; n^1, centre of gravity at Jupiter's mean perihelion and Saturn's mean aphelion. The four principal planetary masses are so proportioned to their distances, and their distances are so proportioned to those of Mars and the Earth, as to give the following arrangements in the typical ellipse.

	A	B	Centre.	C	D
1	m p	☉	.	.	m a
2	☉	♃ p	.	.	♅ a
3	n p	☉	.	.	n a
4	$n_1 a$.	♃ p	.	.	$n_1 p$
5	☉	2 ♂ p	.	m p	.
6	☉	2 ♂	.	♄ p	.
7	☉	2 ♂ a	.	♄ a	.
8	♂	⊕	.	☉	.

It is well to observe that the relation of Mars's radius vector to octave nodes of the asteroidal belt is indicated by these configurations, as well as by the π series in my communication of April 4th (π^{-2} ♆ — 2 ♂).

If we accept Newton's hypothesis, that the æther is a material medium, by means of which the mutual gravitating action of masses is exerted, the modulus of light may be determined by the same laws as the modulus of elasticity in air, steel, or other terrestrial elastic bodies, and its determination gives significance to the following relations:

1. The half-modulus, is to Jupiter's distance from the Sun's surface, as the Earth's distance from the Sun's surface, is to solar radius (or the distance of the Sun's centre of gravity from its surface).

2. The quotient of the solar mass by the aggregate planetary mass is to the quotient of the mean aphelion by the mean perihelion radius vector of the Solar-Jovian centre of gravity, as the velocity of light is to the velocity of planetary revolution at the mean perihelion Solar-Jovian centre of gravity.

3. The aggregate mass of the Jovian System (♃, ♄, ♆, ♅), is to that of the Telluric System (⊕, ♀, ♂, ☿), as Earth's radius vector, is to Sun's radius.

4. The aggregate mass of the principal planetary pair in the extra-asteroidal belt (♃, ♄), is to the mass of the principal planetary pair in the intra-asteroidal belt (⊕, ♀), as the Earth's distance from the Sun, is to solar radius.

5. The aggregate mass of the exterior planetary pair (♆, ♅), is to the mass of Saturn, as Saturn's mean aphelion distance, is to Neptune's mean distance from the Sun.

6. The aggregate mass of the smaller planetary pair in the terrestrial belt (♂, ☿), is to the mass of the larger pair (⊕, ♀), as the force of solar gravitation in any planetary orbit, is to the force at the planet's reverse centre of linear oscillation (1 : 9).

The aggregate mass of the inner planetary pair of the terrestrial belt (♀, ☿), is to the mass of the outer pair (⊕, ♂), as twice the square of the radius of spherical gyration, is to the square of the equatorial radius. The uncertainty as to the mass of Mercury, renders the last two ratios more doubtful than the three preceding. In order to make them equally satisfactory, it may be necessary to take account of intra-Mercurial planets or planetoids.

8. The mean annual motion of Neptune's perihelion, is one-sixth of that of Uranus; that of Uranus being one-sixth of that of Saturn. The mean perihelion distance of Mars, is one-sixth of the distance of mean centre of gravity of Neptune and Uranus at their opposition. Its mean distance is one sixth of Saturn's mean perihelion distance; its mean aphelion distance, one-sixth of Saturn's mean distance.

9. Terrestrial superficial gravity, is to solar superficial gravity, as Sun's radius, is to one-third of the mean distance of Mercury from the Sun's surface.

10. There are numerous relations between the varying positions of the center of gravity of Saturn and Jupiter, which seem to corroborate the nebular hypothesis and to encourage careful investigation.

11. The aggregate mass of Jupiter and Mars, is to the aggregate mass of Saturn and Earth, as the quotient of Saturn's aphelion by Earth's mean distance, is to the quotient of Jupiter's perihelion by Mars's aphelion.

12. The aggregate mass of Earth and Mercury, is to the aggregate mass of Venus and Mars, as the quotient of Mars's mean aphelion by the radius of spherical gyration in Earth's orbital æthereal sphere, is to the quotient of Earth's perihelion distance by Mercury's aphelion distance. This proportion, like the fourth and fifth, is affected by the uncertainty of Mercury's mass.

13. The Sun's radius is a mean proportional between its centre of gyration and the conjunctive centre of gravity of Sun, Jupiter's perihelion, and Saturn's perihelion.

14. The quotient of Sun's mass by Jupiter's mass, is to the fourth power of the quotient of the time of planetary revolution by the time of fall to the orbital center, as the mean perihelion distance of the center of gravity of Sun and Jupiter, is to Sun's radius.

15. The solar mass, is to the aggregate planetary mass, as the square of the gravitating force at the Sun's surface is to the square of the gravitating force at the Earth surface.

16. The solar mass, is to the aggregate planetary mass, as Sun's radius is to $(\frac{1}{3})^3$ of the secular mean radius vector of the perihelion center of gravity of Sun and Jupiter.

17. The solar mass, is to the aggregate planetary mass, as the gravitating force at the Sun's surface, is to the gravitating force at the linear centre of oscillation between Mercury and the Sun's surface.

18. Planetary velocity at the mean perihelion center of gravity of Sun and Jupiter is equal to $(\frac{1}{3})^3$ of the velocity of light.

19. Jupiter's mass, is to Saturn's mass, as ⅓ of Saturn's mean aphelion distance, is to Earth's mean distance from the Sun.

20. Saturn's mass, is to Earth's mass, as the quotient of Saturn's mean aphelion distance by Earth's radius, is to the quotient of Earth's mean distance by Saturn's radius.

21. Saturn's mass, is to Neptune's mass, as the quotient of Jupiter's mean aphelion distance by the distance of the mean perihelion center of gravity of Sun and Jupiter, is to the quotient of Earth's mean distance by Sun's radius.

22. The mass of Uranus, is to Earth's mass, as the vector-radial quotient of Uranus's center of oscillation by Sun's radius, is to the quotient of Earth's mean distance by mean perihelion centre of gravity of Sun and Jupiter.

23. The mass of Uranus, is to Neptune's mass, as $\pi : 4$.

24. The mass of Venus, is to Earth's mass, as $\pi : 4$.

25. The mass of Jupiter, is to the mass of Neptune, as a mean proportional between Saturn's mean aphelion distance and Neptune's mean perihelion, is to the Earth's mean perihelion distance.

26. The mass of Jupiter, is to Earth's mass, as the product of Saturn's mean aphelion distance by Neptune's mean distance, is to the square of Earth's mean distance.

27. Neptune's mass, is to Earth's mass, as the continued vector-radial product of Sun and Jupiter's mean perihelion centre of gravity, Mars's mean aphelion, and Saturn's mean aphelion, is to the product of Sun's radius by the square of Earth's mean distance.

COMPARATIVE TABLE OF THEORETICAL AND OBSERVED VALUES.

		Theoretical.	Observed.
Mean Inertial Moment of Jupiter..........		Equal.	258,200
" " Saturn........			259,627
" " Uranus ÷ π ..		"	482,378
" " Neptune......			480,429
⅓ Light Modulus ÷ ♃.	(1)..........	213.36	213.71
Velocity of Light.	(2)..........	184,200	183,450
♃ System ÷ ⊕ System,	(3)..........	214.86	214.88
(♃, ♄) ÷ (⊕, ♀).	(4)..........	214.86	217.62

		Theoretical.	Observed.
(♆, ♅) ÷ ♄,	(5)..........	3.004	3.000
♂, Mean Perihelion,	(8)..........	1.4048	1.4032
♂, Mean,	"	1.5129	1.5237
♂, Mean Aphelion,	"	1.6667	1.6442
☉ *g* ÷ ⊕ *g*	(9)...........	27.39	27.29
(♃, ♂) ÷ ♄, ⊕),	(11)..........	3.3027	3.3091
(☉, ♃, ♄) Center of Gravity,	(13)..........	1.5812	1.5741
☉ ÷ ♃,	(14)..........	1044.25	1048.88
☉ ÷ Planets,	(15)..........	744.86	747.15
" "	(16)..........	743.41	747.15
" "	(17)..........	750.27	747.15
Velocity of Light,	(18)..........	183,570	183,450
♃ ÷ ♄,	(19)..........	3.3333	3.3448
♄ ÷ ⊕,	(20)..........	90.621	89.408
♄ ÷ ♆,	(21)..........	5.322	5.347
♅ ÷ ⊕,	(22)..........	13.041	13.083
♅ ÷ ♆,	(23)..........	.7854	.7825
♀ ÷ ⊕,	(24)..........	.7854	.7845
♃ ÷ ♆,	(25)..........	17.848	17.886
♃ ÷ ⊕,	(26)..........	300.37	299.05
♆ ÷ ⊕,	(27)..........	16.767	16.720

The observed values in this table are computed from the data given by Norton and Stockwell.

III. HARMONIES OF COSMICAL ROTATION.

The numerous indications of arithmetical, harmonic, and geometrical progression which I have pointed out, are such as might have been anticipated, if we regard the æther as a material medium of extreme elasticity, by means of which all forms of material force are transmitted.

Chladni's experiments gave abundant evidence of the tendency of sonant vibrations to produce nodal and symmetrical aggregations of material particles ; the drinking-glass experiments show that the tendency is sometimes sufficient to overcome cohesive or other attractions which oppose the symmetry ; Mossotti's hypothesis, that the radius of each particular material nucleus may be almost infinitesimal in comparison with the radius of the æthereal atmosphere by which it is surrounded, makes it comparatively easy to believe that even suns and planets may be influenced as to position, volume, mass, and motion, by harmonious vibrations which are transmitted from particle to particle until they pervade and control the whole mass.

Rotation, as well as revolution, is one form of oscillation, and therefore subject to the same general laws as the swing of pendulums, the undulation of liquids, the sonant and luminous tremors of elastic solids, fluids, and æthers. Some evidences of its being subject to rhythmical influences may be found in the approximate agreement between the lengths of days both in the Jovian and in the Telluric planetary belt. Other and more satisfactory evidences are deducible from such comparisons of uniform and variable motions as are naturally suggested by the foregoing investigations.

Among the correlations in the preceding article, the following seem peculiarly significant:

1. The close coincidence between the vectorial ratio of Jupiter to the half-modulus of light, and that of Sun's radius to Earth; Jupiter and Earth being the controlling masses of their respective planetary belts.

2. The ratio which connects the velocity of light, the proportionate masses of Sun and Planets, the velocity of planetary revolution about the Sun, the variations of position in the center of gravity of the two principal masses of the System (☉, ♃), and the consequent orbital eccentricity of Jupiter.

3. The comparative commensurability of the Jovian and Telluric Systems, Sun's radius and Earth's radius vector.

13. The mean proportionality of Sun's radius between the radius of its centre of gyration and the radius of the centre of gravity of the three principal masses of the System (☉, ♃, ♄).

n, n^1. The ratios which fix the elliptical orbits of the relative mean aphelia and perihelia of Jupiter and Saturn and the eccentricity of Mars, the planet which links the Telluric to the asteroidal belt.

I have already invited attention to the approximate mean proportionality between the distances of Mercury and Neptune from the Sun's surface, and to the resemblances between the gamuts of sound and light. If we regard the condensation of planets and the gaseous elasticity of their envelopes as both resultants of æthereal elasticity, we may naturally look to logarithmic curves of the second order for some interesting comparisons.

If we divide the planetary octave into twenty-four (— 3×2^3) quarter tones and consider Jupiter's mean perihelion as occupying the logarithmic centre of oscillation ($2^{\frac{2}{3}}$ *log.* ☿), we obtain the geometrical series of logarithms in column *ld* of the following table, the *ratios* of the logarithms being represented by the gamut ratios $(2)^{\frac{n}{24}}$. For comparison, I have also given the logarithms of actual distance, ld^1; the theoretical and actual distances, d, d^1; and the proportionate wave-lengths of the eight principal Fraunhofer lines *Fr.* Planetary perihelion, mean, and aphelion distances are represented, respectively by p, m, a, in accordance with Stockwell's estimates of the secular mean values.

LOGARITHMIC PLANETARY GAMUT.

	Fr.	$(2)^{\frac{n}{24}}$	*ld*	ld^1	d	d^1
☿ m	H 1.000	1.000	1.908294	1.919977	80.96	83.17
		1.029				
		1.059				
	G 1.095	1.091				
		1.122				

	Fr.	$(2)^{\frac{n}{24}}$	*ld*	*ld*^{1}	*d*	*d*^{1}
♀ *a*		1.155	2.204751	2.206566	160.23	160.90
		1.189				
⊙ *m*	F 1.235	1.224	2.335855	2.332155	216.70	214.86
		1.260				
		1.297				
♂ *a*	E 1.339	1.335	2.547265	2.548099	352.59	353.26
		1.374				
		1.414				
		1.456				
	D 1.498	1.498				
		1.542				
♃ *p*		1.587	3.029231	3.029231	1069.62	1069.62
		1.634				
	C 1.668	1.682				
♄ *m*	B 1.746	1.731	3.303395	3.311651	2010.92	2049.51
		1.782				
		1.834				
♅ *p*		1.888	3.602383	3.595130	4002.97	3936.68
	A 1.934	1.943				
♆ *a*		2.000	3.816507	3.814149	6555.36	6518.52

This hypothetical duplication of elastic influence, substitutes for the variable influence of gravity, an influence which is supposed to be uniform, in all places and at all distances. In order to find whether gravity can be represented by the resultant of such an influence, let

g = force of gravity at d.
d = perispheral distance of planet or satellite in parabolic orbit.
v_0 = " velocity " " " "
v_1 = velocity of rotation at spheroidal centre of gyration.
v_2 = " primary undulation which originates rotation and revolution.
t_0 = time of undulating action required to produce v_0.
d_0 = distance of virtual gravitating fall or of actual undulatory progression in t_0.

Then, $g \propto \frac{1}{d^2} \propto v_0^4 \propto t_0^4 \propto d_0^2$.

If an attracting spheroid were built up by aggregation of matter, urged simultaneously from all directions towards a resisting nucleus, the limit of velocity, v_0, would be retarded by internal work as soon as the particles began to come into mutual collision. This retardation would lead to centripetal condensation, with a

$$v \propto g \propto d.$$

By the law of equality of areas, if the sphere be imagined to be homogeneously expanded to a radius d, the mean velocity, or v_1, should vary as $\frac{1}{d}$; v_0, as $\left(\frac{1}{d}\right)^{\frac{1}{2}}$; and, v_2 being constant, $v_0 = \sqrt{v_1 v_2}$.

The values v_0 and v_1 are known, at least approximately, for Earth, Moon, Sun, Mercury, Venus, Mars, Jupiter, Saturn; we have, therefore, the means of approximating to the velocity of primary undulation (v_2) with which each of those orbs is accordant, and perhaps, of lending indirect confirmation to the estimates of v_0 and v_1. The values in the following table are given in miles per hour; the computed values are marked C, the observed, O; the column of equivalents gives the velocities which are expressed numerically in the preceding column (v_2 O).

VELOCITY OF UNDULATIONS ACCORDANT WITH ROTATION.

	Log. v_0	Log. v_1	v_2 C.	v_2 O.	Equivalents.
⊕	4.397669	2.818189	948,743	946,550	plan v at c. g. ⊙, ♃ *p*.
☽	3.722803	.816385	4,251,470	4,249,480	v light × ⊙r ÷ ♀ *r. vec.*
⊙	6.130913	3.446620	653,440,000	660,434,400	v light.
☿	4.121473	2.387331	717,158	716,900	plan v at $\frac{15}{9}$ ⊙ *r*.
♁	4.355607	2.807660	800,856	801,860	" at 1.421 ⊙ *r*.
♂	4.011997	2.598377	266,451	267,290	" at 9 × " "
♃	5.112849	4.248874	948,350	946,550	" at c. g. ⊙ ♃ *p*.
♄	4.894799	4.133748	452.742	452,400	" at π × 1.421 ⊙ *r*.

The most satisfactory of the accordances is undoubtedly the one identifying the velocity, of the primary undulation which is in simultaneous accordance both with the planetary velocities and with the velocity of solar rotation, with the velocity of light. This furnishes, as it seems to me, a crucial test of Newton's hypothesis that gravitating action is transmitted through the medium of the same æther to which Huyghens attributed the undulations of light. Challis's Hydrodynamic Researches (P. Mag., 1862, sqq.), and Norton's Investigations in Molecular Physics, (Am. Jour. of Sci., 1864, sqq.) have shown that the phenomena, both of attraction and of repulsion, can be produced by elastic undulation, and if the undulating velocity is the same in the two great sources of cosmical and molecular phenomena, solar radiation and attraction, what more can we ask for their complete identification, as opposite phases of a single primordial activity?

There is, however, still a discrepancy of about one per cent. between the computed and observed values of our supposed equivalents. This difference is exceedingly slight, it is true, and it could be readily overcome by adopting values, for the period of solar rotation and the solar radius, which are quite as probable as those I have employed. But such a forced agreement would render the result less, rather than more satisfactory. It is well known that there is a degree of uncertainty in each of the elements of the equation, greater than the one indicated by the result. This uncertainty must therefore remain, until it is reduced by more accurate observations, more careful study of modifying influences, and more complete comparison of such investigations, in various fields of research, as may help to illustrate the nature and degree of æthereal elasticity and the laws of its action.

In the case of the Moon, we have a virtual particle resting on the surface of a rotating æthereal sphere, and therefore synchronous in its periods of rotation and revolution. The mean velocity of the spheral synodic rotation, ($2\pi \times 238{,}800 \times \sqrt{.4} \div 708.73$), if reduced in the ratio which would be required by solar expansion to Earth's mean perihelion, (207.58), would give $v_1 = 6.45$. Combining this with the velocity of v_0, (65,462.4), we obtain $v_2 = 664{,}100{,}000$, which is still nearer to the estimated velocity of light than the value deduced from solar rotation. This deduction appears, in some respects, more satisfactory than the one in the table, but I have preferred giving them both, in order to show that all rotation may probably be ultimately traceable to undulations having the velocity of light, and to exhibit, at the same time, the curious confirmation of my view, that "Venus may be regarded as an exterior satellite of the Earth, at a limit analogous to that of the solar system" (*ante.* xii, 409).

The accordance of v_2, for the principal planet in each of the asteroidally divided belts (♃, ⊕), with the planetary velocity at the principal centre of gravity in the entire system (⊙, ♃ *p*), is no less interesting in its way, than those which I have already noticed. It may be connected with the velocity of light, by conceiving a rotating æthereal sphere extending to the mean of the mean aphelion distances of Earth and Jupiter ($\frac{1.0339 + 5.4274}{2} = 3.2306$). If such a sphere had the planetary velocity at the Sun's surface, its peripheral velocity would be 663,492,000, which differs by less than one-tenth of one per cent. from the value deduced for lunar v_2 in the foregoing paragraph; and less than half of one per cent. from the estimated velocity of light.

The equivalents of v_2 for Saturn and Venus, are interesting from their introduction of the ratio of the quantity of heat under constant pressure, to the quantity under constant volume, (1.421 : 1). An æthereal sphere extending to the linear centre of oscillation between Saturn's mean aphelion and Jupiter's mean distance, ($\frac{2 \times 5.203 + 10}{3} = 6.802$), and rotating with the velocity of Saturn's v_2 at the Sun's surface, would have a peripheral velocity of 661,659,000, which differs by less than one-fifth of one per cent. from the estimated velocity of light. A similar sphere for Venus, limited by the mean between the same Saturnian centre of oscillation and Earth's mean distance, ($\frac{10}{3} + \frac{1}{2} = 3.83$), would have a peripheral velocity of 659,608,000, differing less than one-eighth of one per cent. from the luminous velocity.

The values of v_2 for the exterior planets of the Telluric belt, (☿, ♂), are in simple harmonic relations to the planetary velocity at the Sun ($\frac{3}{4}$ ⊙) and to Venus's v_2 ($\frac{1}{3}$ ♀). The radii, of the æthereal spheres which are determined by the peripheral velocity of light and the solar superficial velocity of v_2, are dependent on the mean aphelion reverse linear centre of oscillation of Saturn ($\frac{1}{3}$ of 10) and the mean distance of Jupiter, for Mercury, ($\frac{\text{c.o.}\,♄ + ♃}{2}$) and Saturn's mean perihelion reverse centre of linear oscillation ($\frac{1}{3}$ of 9.078) and Uranus's mean aphelion (20.0432) for Mars,

$\left(\frac{\text{c. o. ♄} + ♅}{2}\right)$. The latter coincidence is within less than one seventieth of one per cent.

The synchronism, between light oscillations from Sun to Uranus's mean aphelion and planetary revolution at Sun's surface, lends interest to the following approximate ratios of the spheral radii to Uranus's mean radius vector: ☿, $\frac{2}{9}$; ♀, $\frac{1}{5}$; ⊕, $\frac{1}{6}$; ♂, $\frac{3}{5}$; ♃, $\frac{1}{6}$; [♄ $\frac{1}{3}$ aphelion *r. v.*]

ÆTHEREAL SPHERES OF ROTARY UNDULATION.

Spheral *r*.		Periph'l *v*.	Vel. of light.
☿ (♄ *c. o.*,* ♃)	mean.	657,654,500	660,434,400.
♀ (♄ *c. o.*, ⊕)	“	659,608,000	“
⊕ (⊕, ♃)	“	663,492,000	“
♂ (♄ *c. o.*, ♅)	“	660,348,000	“
♃ (⊕, ♃)	“	663,492,000	“
♄ (♄, ♃)	c. o.	661,659,000	“

COMPARISON OF HARMONIC AND ACTUAL SPHERAL RADII.

	Approximate.					Actual.
☿	$\frac{2}{9}$	♅	mean	915.91	× ⊙ *r*.	920.91
♀	$\frac{1}{5}$	“	“	824.32	“	824.66
⊕	$\frac{1}{6}$	“	“	686.93	“	696.11
♂	$\frac{3}{5}$	“	“	2472.95	“	2478.64
♃	$\frac{1}{6}$	“	“	686.93	“	696.64
♄	$\frac{1}{3}$	“	aphelion,	1435.50	“	1458.75

IV. WEATHER STUDY.

In the "American Weather Notes," which I had the honor of communicating to the Society at its meeting of March 8, 1871, I first called attention to the comparative frequency of anti-cyclonic storms, and to some other pecularities of meteorological phenomena which indicate the importance of regarding Espy's lines of indraught, as well as Redfield's centres of cyclonism, in making weather forecasts. I subsequently showed (*ante*, xii., 65, 123) that the general atmospheric movement in America is anti-cyclonic, while in western Europe, where I had looked for very marked cyclonism, anti-cyclonic are nearly as frequent as cyclonic currents; and that two of our principal storm centres are situated near normal intersections of polar and equatorial currents.

An abstract of my views was subsequently published in the manual of the Signal Service Bureau, and the officers of the Bureau have communicated to the public journals some remarkable evidences of anti-cyclonism in storms of great magnitude. It therefore seems desirable to ascertain the extent of this apparent exception to the generally received law of storms, and I have accordingly undertaken some special study of the weather maps, in order to ascertain how far my ideas are sustained by two years' additional systematic observations. The results of such study seem to me to be important enough to justify others in entering on a similar examination, and I hope the investigation may interest a sufficient number of inquirers to successfully eliminate any influence of personal bias, and to establish new and valuable meteorological laws.

---

* It is well to remember that Saturn's centre of linear oscillation is at the centre of gravity of the planetary system, and its reverse centre is at the octave node of the centre of gravity.

My weather maps are all of the morning issue, exhibiting the daily official returns of thermometer, barometer, wind, cloud, rain, and snow, at 7.35, A. M., Washington mean time. In order to estimate the comparative frequency of cyclonic and anti-cyclonic storms, I first arranged, in respective columns, such as belonged unmistakably to either class. When it was impossible to determine the character of the current, I counted all that were at and below the barometric mean, as cyclonic; all that were near the crest of the barometric wave, as anti-cyclonic; all that were still left in doubt, as adding equal weight to each column. This classification, based on Ferrel's well known-principles, gave "the benefit of the doubt" in all instances to the cyclonic theory, and, if it is chargeable with partiality in either direction, I hope the partiality will prove to be towards the views which are in opposition to my preconceived opinions.

The number of observations is probably insufficient, and the extent of the comparison too limited to justify any very general conclusions, but there appears to be sufficient consistency in the results to render it probable, that even after storms are well developed and considerable precipitation has taken place, the currents continue anti-cyclonic in proportions varying from one-fifth to more than two-fifths of the whole number of observations, the proportion being greater in winter than in summer. The following table exhibits the number of morning rains (R) and snows (S) classed as cyclonic (C), and anticyclonic (A), together with the normal percentages of each, as determined by a simple smoothing of the resulting curves:

CLASSIFICATION OF AMERICAN STORMS.

	Observed.				Normals.			
	C R A		C S A		C R A		C S A	
January	30	14	48	33	67	33	61	39
February	38	16	39	33	70	30	62	38
March	35	11	47	16	70	30	68	32
April	20	14	8	4	69	31	76	24
May	31	10	4	0	70	30	78	22
June	23	8			71	29		
July	18	10			71	29		
August	21	6			73	27		
September	23	9			73	27		
October	24	8	3	2	71	29	72	28
November	39	21	37	20	67	33	66	34
December	30	21	46	25	64	36	62	38
Winter	201	99	185	115	67	33	62	38
Spring	209	91	222	78	70	30	74	26
Summer	215	85			72	28		
Autumn	211	89	138	62	70	30	69	31
Year	836	364	545	255	70	30	68	32

In a few instances a line of rainfall with double curvature has been strikingly marked, extending almost from the summit of an atmospheric crest to the foot of an adjacent valley, thus exemplifying the accuracy of Ferrel's deductions, and encouraging the belief that close and systematic study of the tri-daily maps, under the guidance of those deductions, will render the future success of our Signal Service Bureau even more marvelous than the past.

Some stations seem to be exposed to peculiar local anti-cyclonic influences. Although the number of stations is insufficient for an entirely satisfactory study of such influences, and although I have given no special attention to their investigation, having merely noted a few of the anomalies which seemed most striking, I will venture to suggest a careful tabulation and examination of reports from Shreveport, Lynchburg, Denver, Cheyenne, Pittsburg, and St. Louis, with a view to subjecting any exceptional indications, which they may furnish, to a rigid scrutiny. I have sometimes been inclined to attribute irregularities, which seemed to be of a systematic character, to imperfections in the instruments of observation, but the careful comparisons to which they are subjected before leaving the Washington office, seem to make such a hypothesis less probable than the one which looks to local perturbations, originating in peculiarities of physical position.

The tendency to parallelism of atmospheric currents, both in vertical and horizontal planes, seems to be indicated in a large majority of the maps. The isolation of opposite horizontal currents appears, however, to be more complete than that of the vertical currents. So generally is this the case that I doubt if there is *ever* any considerable blending of upper and lower strata of air, except when a partial vacuum has been brought about by great condensation of vapor through the whole height of contiguous polar and equatorial currents, which are moving in opposite directions in the same stratum. If my belief is well founded, the cyclonism or anti-cyclonism of storms at their beginning should depend mainly on the relative position of the mixing currents. As a general rule, if the condensing current is east of the vapor-saturated current or between the vapor current and the equator, the storm should be anti-cyclonic, unless, and until, local precipitation has been copious enough to reverse the normal direction of the blending winds. If the relative position of the vapor-bearing and cooling currents is reversed, the storm should become more speedily and increasingly cyclonic, the precipitation should be more rapid, the winds more violent and tempestuous, the conditions in other respects, such as pressure, vapor-saturation, temperature, and velocity of wind at the outbreak of the storms, being the same. These views seem to be confirmed by the facts which I have adduced in previous papers, as well as by the special examination of which I am now treating, but for that very reason I prefer to submit them, by simple statement, for examination and test by others, who are either wholly free from any prepossession, or whose bias is different from my own; my wish being rather to get at the truth, than to build up or overturn any plausible theory.

On some accounts it would be desirable to have observing stations as thickly scattered over our whole domain, as they are in England and some other European countries. But on the whole, I think, that at least for the time being, the gain is greater than the loss in having such diffusion of reports as will facilitate the early discovery of practical general laws, the influence of which might be obscured by the perplexities of local disturbances, if the stations were twice as numerous. A great part of the success of American meteorology, to which some of our foreign competitors have given the palm with almost envious reluctance, may have sprung from the broad generalizations which were at first forced upon the Meteorological Committees of the American Philosophical Society and the Franklin Institute, by the magnificent breadth of the Mississippi Valley, and the consequent unbroken sweep afforded to the winds that break over the ridges of the Rocky Mountains, or pour from the Arctic Regions through the Valley of the Saskatchewan and across the great lakes. The time will, however, soon come, if it has not already come, when the need of more minute details will become evident, and when State Legislatures, Scientific bodies, or local Boards of Trade, should devise means for supplementing, or use their influence for widely enlarging, the magnificent work of the National Bureau.

The plan of recording observations at all the stations at the same actual time, is undoubtedly the best for determining the mechanical forces which are operating for producing meteorologic changes, and consequently for the general purposes of weather forecast. It is, however, attended with some inconveniences, especially in regard to temperature, the estimated direction of isabnormal thermograms being liable to error on account of inadequate allowances for differences of local time. The importance of those thermograms may be readily understood. The barograms determine the gravitating influences of the moment, and the forces that are now operating to effect the changes of a few succeeding hours; but if we wish to estimate the probabilities for a day or more in advance, we must regard the probable changes in the barograms themselves. Those changes are mainly dependent, either directly or indirectly, upon changes of temperature, the direct influence being manifested by increase or diminution of atmospheric density; the indirect, by condensation of moisture, in the form of rain or snow, and all the other attendant phenomena. Each centre, line, or area of precipitation, becomes a pivot or link between the upper and lower aerial currents, since there must be a downthrust, as well as an indraught, to supply the place of the condensed vapor. The degree and the rapidity with which the lower will be affected by the upper currents, will depend upon the number, position, and extent of storm areas; and a knowledge of the difference of temperature from the normal temperature for the month at each station, would be of great service in fixing the probable sites of precipitation, and the probable cyclonism or anti-cyclonism of the winds.

If the molecular, or elastic forces are so important as they seem to be, not only in the atmospheric and ocean tides, but even in determining the arrangement, masses and motions of cosmical bodies, it is desirable that they should be made the subject of special and critical study in connection with meteorologic changes.

V. THE PLANETARY NODE BETWEEN MERCURY AND VULCAN.

Any speculations upon the probable position of a planet between Mercury and Vulcan may seem premature, so long as the existence of Vulcan itself is so very problematical. I am inclined to believe that any planetoid bodies that may be found between Mercury and the Sun will prove to be very minute, perhaps of an order of magnitude like the asteroids. It is true that the harmonic coincidences on which I have based my hypothesis of an inter-Mercurial pair, may be merely accidental, but when the agreement is so curious and close as I have shown it to be, it is surely well to see whether we can find any other evidence, either to confirm or contradict its manifest indications.

Near $\frac{7}{10}$ of Jupiter's perihelion (3.485) is the first term of the terrestrial harmonic series (3.5).

Near $\frac{7}{10}$ of Earth's mean distance (.7) is Venus's mean distance (.723).

Near $\frac{7}{10}$ of Mercury's mean distance (.271) is the hypothetical planetary node (.269).

Near 3 times the hypothetical nodal distance (.807) is the octave node of Venus's and Earth's perihelia (.832).

Near 9 times the hypothetical nodal distance (2.421) is the outer node of Sun and Jupiter's perihelion (2.494).

Near 27 times the hypothetical nodal distance (7.263) is the octave node of Jupiter's perihelion and Saturn's mean distance (7.259).

Near 81 times the hypothetical nodal distance (21.789) is the spheroidal centre of gyration of Neptune's perihelion, as referred to Saturn's perihelion, (22.138).

Near 81 times the distance of Sun—Jupiter perihelion centre of gravity (81.56) is Mercury's mean distance.

The ratio of Saturn's mean aphelion to Earth's mean distance (10), is nearly a mean proportional, between the ratio of Vulcan's harmonic distance (.209) to the linear centre of oscillation of solar retardation (.169), and the ratio of Mercury's mean distance to the distance of the solar-Jovian perihelion centre of gravity ($\frac{209}{169} \times 81.56 = 10.043^2$).

Stated Meeting, May 16*th*, 1873.

Present 23 members.

Letters accepting membership were receved from George F. Barker, dated University of Pennsylvania, Philadelphia, May 2d; Joseph Le Conte, and John Le Conte, dated University of California, April 29th, 1873.

Letters of envoy were received from the R. Saxon Society, dated Leipsig, Dec. 1st, 1872, and the Swiss Society of Natural History, dated Bern, Nov. 11th, 1872.

A letter of acknowledgment was received from the Society at Bern, dated Nov. 11th, 1873, (83, 84).

A letter requesting the completion of its set of Proceedings of the American Philosophical Society, was received from the Ecole des Mines, dated April 4th, 1873.

The death of Edward King, a member of the Society, at Philadelphia, May 8th, aged 79, was announced by Mr. Whitman, and on motion, Gen. Stokes was appointed to prepare an Obituary Notice of the deceased.

The death of John Stuart Mill, at Avignon, a member of the Society, was announced by the Secretary.

Donations for the Library were received from the Societies at Moscow, Leipsig, Frauenfeld, Stadtamhof, Frankfort-am-M., Berne, Lille, Bordeaux, Salem, Providence, and Buffalo;

the Geological Societies, &c. at Vienna, Berlin, and Florence; the Ecole des Mines, Antiquarian Society, Geographical Society, Oriental Athenæum, Revue Politique, and Prof. Delesse of Paris; the Antiquarian Society, Chemical Society, and London Nature; the Royal Dublin Society; Silliman's Journal; Franklin Institute, Academy of Natural Sciences, Penn Monthly and Mr. Edward Pennington of Philadelphia, and the State Geologist of Indiana.

Mr. Chase offered for publication and explained his views on "Anticyclonic Storms," and on the "Planetary Node between Mercury and Vulcan."

The minutes of the last Stated Meeting of the Board of Officers and members in Council were read.

Pending nomination No. 733 was read.

A discussion respecting the time and manner of publishing the Proceedings of the Society followed, in which Gen. Stokes, Dr. Le Conte, Prof. Cope, Mr. Whitman, Prof. Barker, Mr. Lesley, and Prof. Cresson took part.

And the meeting was adjourned.

ON THE GIGANTIC MAMMALS OF THE AMERICAN EOCENE.

By Professor O. C. Marsh.

(*Abstract of a paper read before the American Philosophical Society, April 4th,* 1873.)

The recent publications of this Society contain a number of papers by Prof. Cope on a group of Eocene mammals which I have called *Dinocerata*, and previously described in the American Journal of Science.[*] In a communication to this Society, December 20th, 1872, I pointed out some of the errors made by Prof. Cope in his descriptions of these animals, and I have since corrected many others elsewhere.[†] As it is important to have the true characters and affinities of the *Dinocerata*, as well as the facts relating to their discovery, placed on record, I desire now to call the attention of the Society to a number of points in which Prof. Cope's various papers on this subject need correction:

1st. The name *Tinoceras*, Marsh, antedates *Eobasileus*, Cope, and the family name, *Tinoceratidæ*, also has priority over *Eobasiliidæ*. 2d. The name *Loxolophodon* is preoccupied, and hence should not be applied to this genus. 3d. *Eobasileus cornutus*, Cope, is a synonym of *Tinoceras grandis*, Marsh. *E. furcatus*, Cope, was based on the posterior horn-cores of known species, and not on the nasal or frontal bones as Prof. Cope supposed. 4th. The genus *Dinoceras*, Marsh, is quite distinct from *Uintatherium*, Leidy, although perhaps nearly related. It differs essentially in the position of the occipital condyles in the more anterior position of the posterior horn-cores, and in the structure of the upper true molars. 5th. The mammals of the above genera constitute a distinct order, *Dinocerata*, which approaches the Perissodactyls rather than the Proboscidians. 6th. There is no evidence, in the osteological characters, of a long proboscis, and much against it. 7th. The *Dinocerata* have no under incisors, and the teeth so called by Prof. Cope are canines. 8th. The nasal bones are much elongated, and the anterior horn-cores are on these bones and not on the frontals. 9th. The frontal bones do not extend in front of the premaxillaries, and they do not support horns or processes at both extremities. 10th. The middle pair of horn-cores are not

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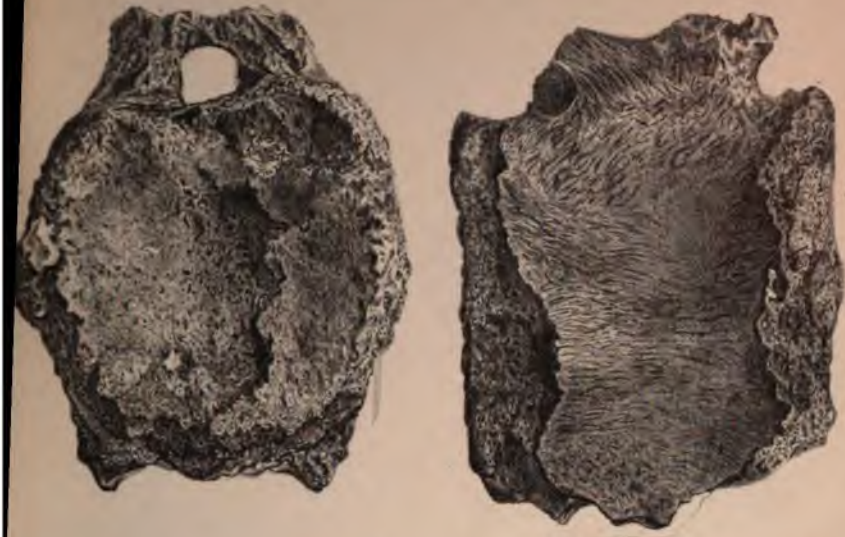
[*] Vol. II, p. 35, July, 1871; Vol. IV, Erratum, Sept., 1872, and pp. 322, 323, 343, Oct., 1872.

[†] Am. Jour. Sci., Vol. V. pp. 117, 293 and 310, 1873. Also Am. Naturalist, Vol. VII. pp. 52, 146 and 217.



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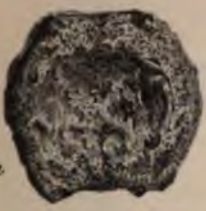

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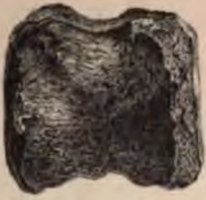

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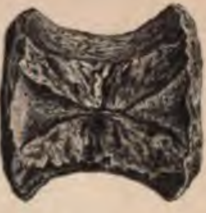

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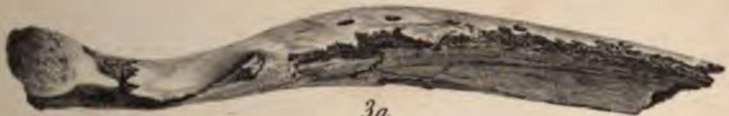

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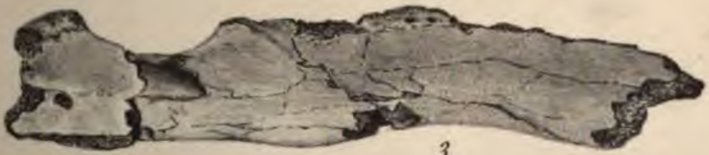

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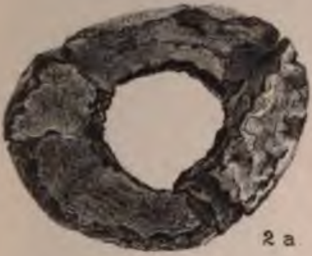
PROCEEDINGS AMER. PHILOS. SOCIETY.

VOL. XII 2

PLATE II.



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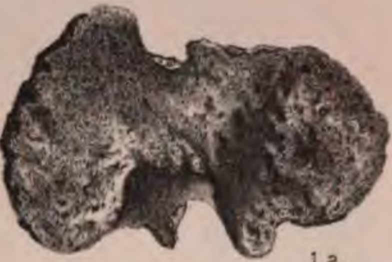

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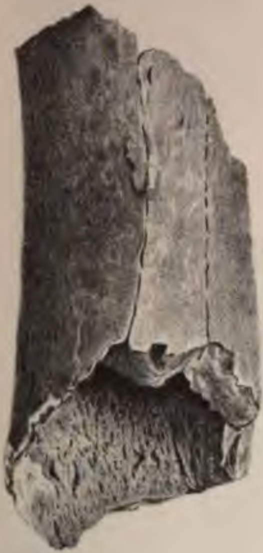

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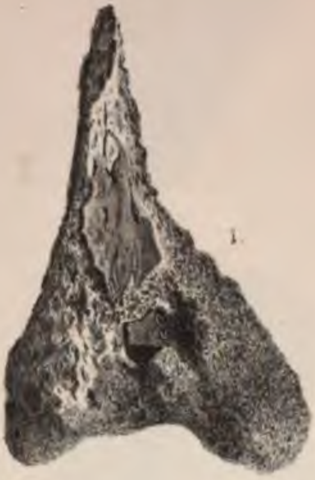

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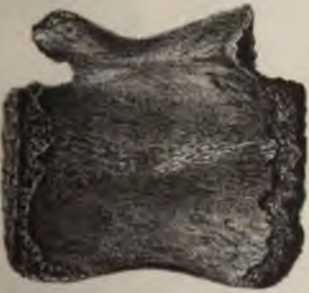

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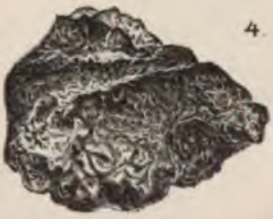

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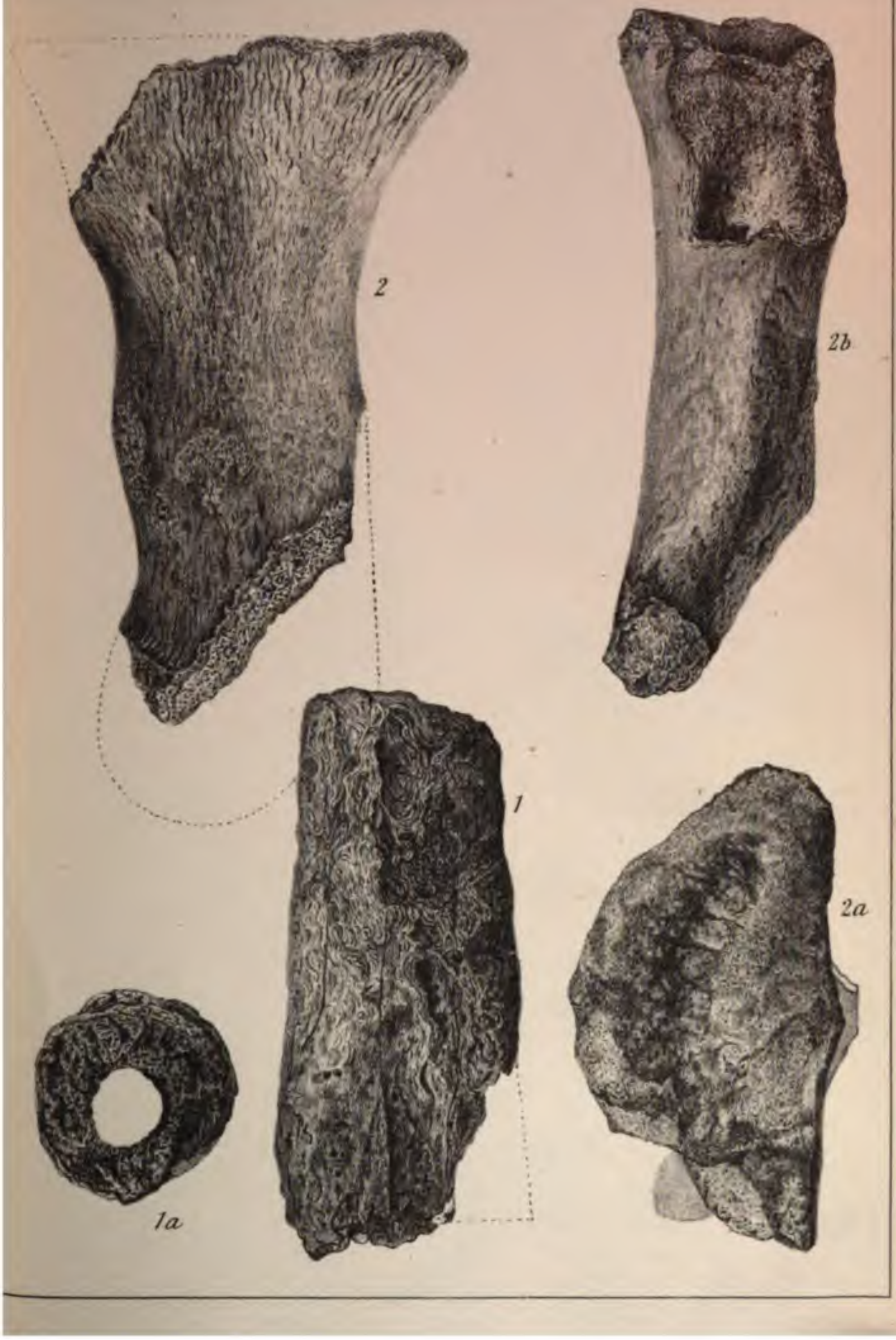
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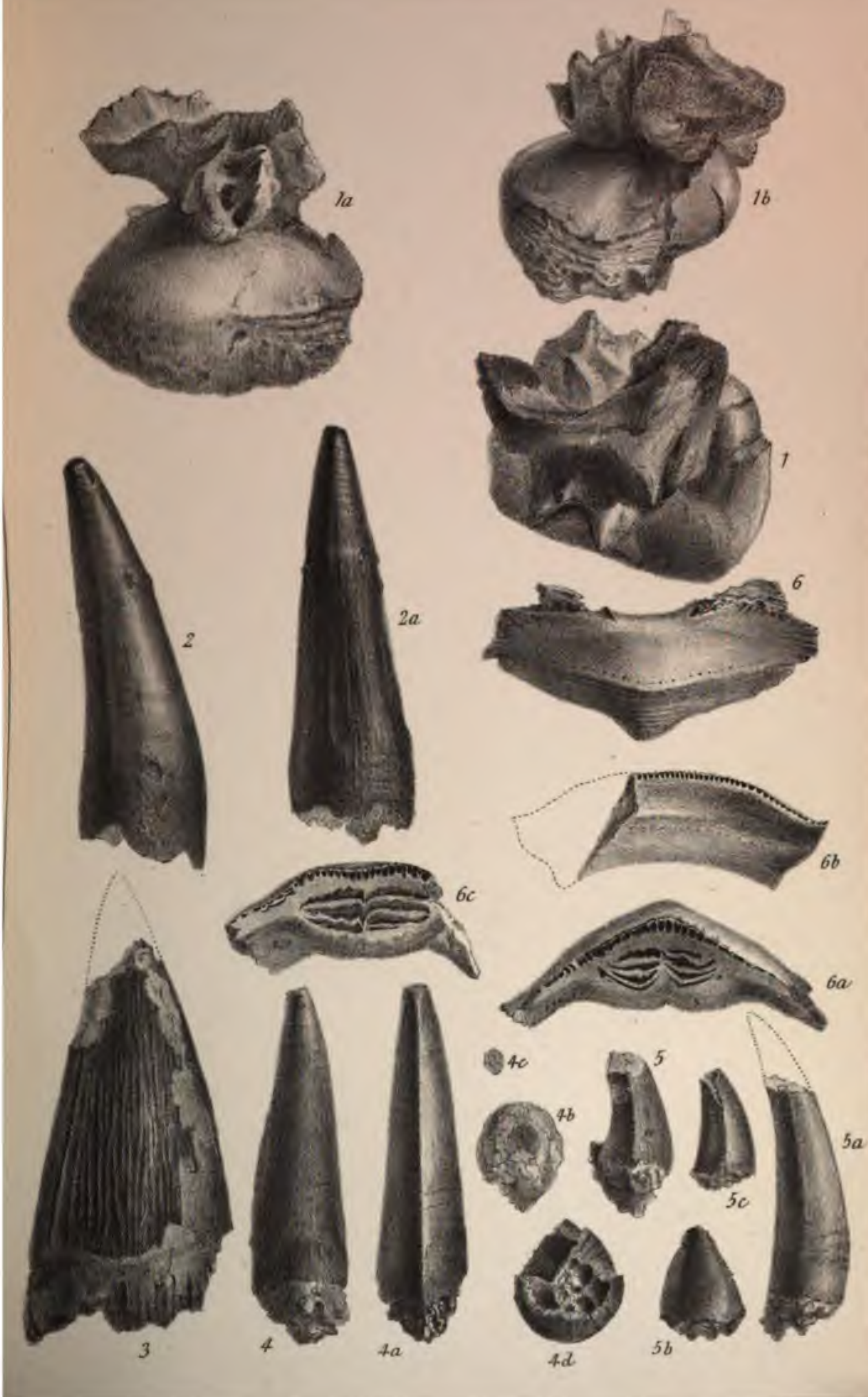
Proc. A.P.S. Vol. XII. *Plate IV.*



CONTENTS.

PAGE.

Stated Meeting, March 7, 1873 154
New Slides to exhibit Light Waves, by Dr. Seiler 155
A map of Anthracite Collieries, by J. W. Hardin, C. E. 155
On the Dunning's Creek Fossil Iron Ore, by J. P. Lesley. *With a Map.* 156
Stated Meeting, March 21, 1873 169
Obituary notice of Charles D. Meigs, M. D., by John Bell, M. D. 170
D. S. Holman's Device for the Microscopic Examination of Fluids 180
Stated Meeting, April 4, 1873 181
Obituary notice of John F. Frazer, by John L. LeConte, M. D. 183
Topography as affected by the Rotation of the Earth, by W. C. Kerr. 190
The Music of the Spheres, by Pliny Earle Chase 193
On the Flat-clawed Carnivora of the Eocene of the Wyoming, by Edward D. Cope 198
Stated Meeting, April 18, 1873 209
On Specimens of Aztec Sculpture, by Prof. Persifor Frazer 210
Election of New Members 211
On the Osteology of the Extinct Tapiroid Hyrachyus, by Edward D. Cope 212
Description of Lesley's Micrometer for Field-note Plotting 230
Stated Meeting May 2, 1873 235
Cosmical and Molecular Harmonies, No. II, by Pliny Earle Chase 237
Correlations of Planetary Mass, by Pliny Earle Chase 239
Harmonies of Cosmical Rotation, by Pliny Earle Chase 243
Weather Study, by Pliny Earle Chase 248
The Planetary Node between Mercury and Vulcan, by Pliny Earle Chase 252
Stated Meeting, May 16, 1873 253
On the Gigantic Mammals of the American Eocene, by Prof. O. C. Marsh 254

NOTE.—*Four plates of North Carolina Fossils intended to be bound into Volume XII* (see page 210, Nov. 17, 1871), *have been delayed in their preparation, and are therefore published in this Number of the Proceedings.*

Dr Jos. Leidy:
1302 Filbert St

PROCEEDINGS

OF THE

AMERICAN PHILOSOPHICAL SOCIETY,

HELD AT PHILADELPHIA, FOR PROMOTING USEFUL KNOWLEDGE.

VOL. XIII. JUNE TO DECEMBER, 1873. No. 91.

CONTENTS.

PAGE.
Stated Meeting, June 20 257
Stated Meeting, July 18 258
Stated Meeting, August 15 259
Stated Meeting, September 19 260
Stated Meeting, October 2 262
Stated Meeting, October 17 263
Stated Meeting, November 7 266
Stated Meeting, November 21 267
Stated Meeting, December 5 269
The Outcrop Belt of the East Kentucky Coal Field (*with a map*), by Joseph Lesley 270
Synopsis of the Histeridæ of the United States, by George H. Horn, M. D 273
Contributions from the Laboratory of the University of Pennsylvania, No. 1. Corundum, its alterations and associated minerals, by F. A. Genth 361
Contributions to a Knowledge of the Curculionidæ of the United States, by George H. Horn, M. D 407
Recent Confirmation of an Astronomical Prediction, by Pliny Earle Chase 470
Comparison of Planetary Series, by Pliny Earle Chase 471
Transcript of a Curious Manuscript Work in Cypher, supposed to be astrological, by Pliny Earl Chase 477
On the Language of the Natchez, by D. G. Brinton, M. D 483
On An Acoustic Phenomenon in the Rocky Mountain 499
On the Meteors of January 2d, by Professor Daniel Kirkwood 501
A Study of the Structure and Erosion of Brush Mountain (*with a map*), by J. P. Lesley 503
Stated Meeting, December 19 505
Index 509

Stated Meeting, June 20th, 1873.

Present, 13 members.

Vice-President, Mr. FRALEY, in the Chair.

Letters accepting membership were received from Sir Wm. Thompson, dated 35 Wimpole St., W. London, May 8th, 1873; Mr. P. L. Sclater, dated Zoological Society, London, May 20th, 1873: Prof. Giovanni Capellini, dated Museo di Geologia, Bologna, May 20th, 1873; Prof. Luigi Palmieri, dated Direzione dell, Osservatorio Vesuviano, Naples, May 12th, 1873; and J. B. De Rossi, dated Rome, May 10th, 1873.

Letters acknowledging the receipt of the Society's Publications were received from the R. Society at Edinburgh, March 18th, (XIV, i, ii, iii, 83 to 86,); Dr. F. Flügel, Leipsig, November 1, 1872 (85, 87,); the Natural History Society at Emden, October 1, 1872 (86, 87,); the Imp. Acad. at Vienna, October 4th, 1872 (XIV, iii, 87, ; P. Tunner, Leoben, September 20th, 1872 (87); Dr. Rokitansky, Vienna, October 12th, 1872 (87).

Letters of envoy were received from the Society at Erlangen, May 2d, and the Society at Batavia, January 20th, 1871, and December 30th, 1871.

A letter from the Grosvenor Library, Buffalo, New York, dated May 31st, 1873, respecting publications, was referred to the Library Committee, with power to take order.

Dr. Horn offered for publication in the Proceedings a paper entitled "A Synopsis of the Histeridae of the United States," with one octavo plate, and gave a verbal description of the paper, as one of the series bringing up the Natural History of the family to the present date. On motion of Dr. LeConte, it was referred to the Secretaries, with power to furnish the required plate.

Mr. Lesley described a map of the Western Outcrop of the East Kentucky Coal Field, from the surveys of Mr. Joseph Lesley, assistant on the State Survey in 1858 and 1859, and offered it for publication in the Proceedings. On motion of Prof. Frazer, it was referred to the Secretaries, with power to act; the expense to the Society not to exceed fifty dollars.

Dr. LeConte communicated a paper by Mr. Augustus Findler, comprising 24 propositions on Gravitation, being a summary of the author's unpublished work on that subject. On motion, it was referred to the Secretaries.

Pending nomination No. 733 was read.

On motion, the request of Prof Cope was granted, to withdraw from the printed Proceedings his paper on the Mammalia Educabilia. And the meeting was adjourned.

Stated Meeting, July 18th, 1873.

Present, 2 members.

, in the Chair.

A letter accepting membership was received from M. Edm. de Selys Longchamps, dated Liège, June 24th, 1873.

Letters acknowledging the receipt of the Society's publications were received from the Leeds Literary and Philosophical Society, June 11th, 1873, (87, 89, wanting 88); the R. Cornwall P. S., September; 22d, 1872 (Proc. for 1870); S. of Antiquaries, London, June 16th, (89); R. Academy, Amsterdam, July 3d, 1872 (86); C. P. Obs., St. Petersburg, November 12th, 1872 (XIV, iii); the Society at Freiburg, March 10th, 1873 (86, 87); and the Society at Riga, November 1st, 1872 (T. VIII; Proc. XIV; 12, 3).

Letters of envoy were received from the Society at Riga, November 1st, 1872; the Entomological Society at Brussels, February 4th, 1873 (requesting exchanges); the R. Acad. Amsterdam, November 6th, 1872; R. Acad., Lisbon, March 25th, 1873; the P. and L. Society at Liverpool, April 9th; U. S. Naval Observatory, June 23d, 1873; and Mr. Richard Vaux, of Philadelphia, June 14th, 1873.

Donations for the Library were received from the Societies at Batavia, Moscow, Riga, Freiburg i B., Bremen, Görlitz, Emden, Erlangen, Liverpool, Providence, Buffalo, Savannah, St. Louis and San Francisco. From the Imp. and Royal Societies at St. Petersburg, Copenhagen, Vienna, Leipsig, Brussels, Amsterdam, Lisbon, Edinburg and Tasmania. From Dr. Von Frauenfeld, of Vienna, M. Barrande of Prag, Dr. C. G. Giebel of Berlin, M. L. Gruner of Paris, the French Geographical Society, Belgian Entomological Society, Royal Institution, British Association, R. Astronomical, Asiatic, Geographical, Chemical, Zoological and Antiquarian Societies. From London Nature, the Massachusetts Historical Society, American Academy at Boston, Yale College, Silliman's Journal, Prof. Roehrig, the Franklin Institute, College of Pharmacy, Medical Journal, American Chemist, Penn Monthly, Dr. Geo. W. Morris, Mr. Henry C. Carey, Richard Vaux, Prof. E. D. Cope, Prof. S. S. Haldeman, the Smithsonian Institution, Census Bureau, U. S. Naval Observatory, and the Peabody Institute of Baltimore.

A notification of the publication of Mr. Grote's papers, by the Buffalo Society of Natural Sciences, was received, dated July 2d, 1873.

A circular from the Zoological Society of Philadelphia, dated May 1st, 1873, with a map of the proposed gardens in the Park, was received.

And the meeting was adjourned.

Stated Meeting, August 15*th*, 1873.

Present, 1 member,

Mr. P. E. Chase.

Stated Meeting, September 19th, 1873

Present, 17 members.

Vice-President, Mr. Fraley, in the Chair.

Letters accepting membership were received from Dr. Hermann Helmholtz, dated Berlin, June 8th, 1873, and M. G. Gougain, dated St. Martin des Entreès, par Bayeux, Calvados, France, July 14th, 1873.

Letters acknowledging the receipt of publications were received from the Hungarian Academy, July 25th (XIV, iii, 87); R. Academia dei Lincei, Rome, January 7th (XIV, iii, 87); the Literary and Philosophical Society, Liverpool, August 21st (89); Harvard College, July 24th (90); New York Historical Society, July 24th (70); Maryland Historical September 16th (90); and Postal Cards of acknowledg ment for No. 90 of the Proceedings from eighty-six members and corresponding societies.

A letter requesting the completion of sets of the Transactions and Proceedings, was received from the Royal Instition in Liverpool, dated August 21st, 1873. On motion, the Librarian was authorized to forward the required publications to Mr. Alfred Morgan, Honorary Librarian of the Institute.

A medal was received from the University of Norway bearing the legend Regni Norvegici Annum Millesimum pia celebrat Universitas Regia Fredericiana; and on the reverse, Tempori Superstes, MDCCCLXXII.

Letters of envoy were received from the R. Geographical Society at Vienna, and from the Norway University

Donations for the Library were announced from the Russian, Prussian, Hungarian and Belgian Academies, the Geographical Societies at Vienna and Paris, the University or Norway, the Vaudoise Society, the Ecole des Mines, Revue Politique, and MM. C. H. Girard and Theo. Wechniakoff of Paris, the London Meteorological Society, Essex Institute, Am. Antiquarian Society, Silliman's Journal, Mr. Verplanck Colvin, Franklin Institute, Journal of Pharmacy, Medical

News, American Chemist and Penn Monthly, the U. S. Secretary of the Interior, the U. S. Surgeon General of the Navy, the Georgia Historical Society, and the Chicago Public Library.

The death of a member, Mr. Elias Durand, at Philadelphia, on the 14th of August, aged 79, was announced by the Secretary, and, on motion, Dr. Carson was appointed to prepare an obituary notice of the deceased.

The death of another member, Mr. William Morris Meredith, at Philadelphia, August 21st, aged 74, was announced by Mr. Fraley, and, on motion, Chief Justice Read was appointed to prepare an obituary notice of the deceased.

Dr. Genth offered for publication in the Proceedings, a paper containing the results of his investigations into the nature and extent of the changes exhibited by pseudomorphis after corundum, which he described, exhibiting typical specimens from the Mineralogical Cabinet of the University of Pennsylvania.

Dr. Horn presented a paper for the Proceedings entitled "Contributions to a Knowledge of the Curculionidae of the United States.

Prof. Frazer adduced facts which he supposed to be confirmatory of Prof. Tyndall's explanation of the blueness of the sky, and gave his own explanation why the moon's disc looks white by day and yellowish after twilight.

Prof. Houston thought that an objection to Tyndall's hypothesis might be found in the greater intensity of the lavender-colored rays.

Mr. Blodgett described the hot season preceding the hurricane of the 18th of August, and showed that the country between the Alleghany mountain and the sea had been slowly invaded from the south, by a mass of saturated tropical air, which finally reached the eastward-moving air of the west and north, and that the storm, which produced such terrible disasters from New York to Labrador, was the consequence.

Mr. Rand testified to the very local character of the abnormal rainfalls of August which wrecked the Chesapeake and Delaware canal banks, and other public works.

Pending nominations, Nos. 733 and 736, and new nominations Nos. 737, 738, 739 were read.

And the meeting was adjourned.

Stated Meeting, October 2d, 1873.

Present, 13 members.

Vice-President, Mr. FRALEY, in the Chair.

Letters acknowledging the receipt of Proceedings were received from the Glasgow Philosophical Society, Sept. 1st, 1873, and Yale College, Sept. 22, 1873 (90).

A letter of envoy was received from M. de Koninck, dated Liège, Sept. 11, 1873.

Donations for the Library were received from the Meteorological Committee of the Royal Society, London, the Essex Institute, the Penn Monthly, and the American Chemist.

Dr. Carson, on the part of Mrs. Jackson, widow of Dr. Samuel Jackson, presented to the Society the original diploma of membership in this Society, given to David Jackson, M. B., of Philadelphia, dated February 4th, 1792, and signed by David Rittenhouse, President; John Ewing, Thomas Jefferson, William Smith, Vice-Presidents; James Hutchinson, Rob. Patterson, Sam. Magaw, and John Williams, Secretaries.

Proofs of the map made by Mr. Bien, of New York, to illustrate Dr. Gabb's Memoir in the Transactions, entitled "Topography and Geology of Santo Domingo," were exhibited.

Prof. Chase offered for the inspection of the members a triangular MS. volume of mystical characters and of considerable age, and described its peculiarities.

Prof. Chase gave the historical development of Bode's, Pierce's and Kirkwood's Astronomical Laws, and compared them with his own harmonic analogy of the solar system.

Pending nominations, Nos. 733, 736, 737, 738, 739, were read.

On motion of Dr. Carson, the Publication Committee was authorized to publish Dr. Gabb's map in duplicate, colored and uncolored.

And the meeting was adjourned.

Stated Meeting, October 17*th*, 1873.

Present, 12 members.

Dr. Carson, in the Chair.

Letters acknowledging the reception of publications were received from the Royal Society, dated London, August 26, 1873 (89); the Linnean Society, August 20, 1873 (89; wanting 88 and XIV, ii); and the Lyceum of Natural History in New York, dated October 6, 1873 (90).

A letter of envoy was received from the New York State Library, at Albany, dated October 2, 1873.

A letter requesting the completion of its series of the A. P. S. Trans. and Proc. was received from the Director of the U. S. Naval Observatory, dated Washington, October 3, 1873.

A letter was received from Mr. F. W. Cristern, foreign bookseller, 77 University Place, New York city, transmitting a request from M. Germer-Baillière, editor of the Cours Scientifiques, published in Paris. On motion, the request was granted.

Donations for the Library were received from the Ecole des Mines, Revue Politique, London Nature, Royal Society, Linnean Society, Mr. Edmund Quincy, Silliman's Journal, New York State Library, Regents of the University of New

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And the meeting was adjourned.

Stated Meeting, October

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Vice-President, Mr. FRALEY

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York, Dudley University, Franklin Institute, College of Pharmacy, Journal of the Medical Sciences, and the Bureau of the Interior.

Prof. Trego described his recent observations on the iron ore deposits of Buckingham Mountain, east of Doylestown, in Bucks Co., Pa., when the lower Silurian limestones and Potsdam sandstone appear at the surface through the covering of the New Red, and bring up their characteristic brown hematites.

Mr. Lesley remarked that this exhibition of the ores was of special importance in refutation of the old opinion that, in the back valleys of Middle Pennsylvania, they originated from the erosion of the ferruginous layers of No. IV Middle Silurian, the nearest outcrop of which is forty miles to the north of Doylestown. The iron is undoubtedly a constituent of the Lower Silurian sand-lime deposits, and the ore-beds are co-extensive with the outcrops of the latter. Another important aspect of the exhibition at Doylestown is evident by comparison of it with the emergence of the Potsdam and Calciferous and Trenton formations, carrying the same ores at Chiquesalunga, on the Susquehanna river, ninety miles west of Doylestown, and on the southern edge of the New Red area. In coming times, the iron masters of Pennsylvania will moot the question of the possibility of reaching these ores under the covering of New Red, just as the English coal operators are at present engaged in discussing the attainability of the Coal Measures, under their New Red areas.

Prof. Houston spoke of the possible, or rather necessarily certain influence of the heat-radiation of the full moon, penetrating as it does the upper fourth or third of the earth's atmosphere, upon climate, and the duty of meteorologists to take account of it in their theory of storms. He inquired if any of the members present had noted a concurrence of low barometer and full moon, or any tendency in winds to move towards the district underlying a full moon. Putting together the two facts of a highly-heated moon surface without atmosphere, and the negative appreciation of said heat by the thermo-electric pile at the bottom of the earth's atmosphere, it seems a necessary consequence that a complete absorption of the lunar-heat radiation must take place in the aqueous vapor of the upper strata of the earth's atmosphere, and this should produce visible effects in meteorology.

Prof. Frazer suggested that these effects should be *in maximo* in winter, or after long cold spells of weather.

Mr. Goodfellow gave it as his experience, in observing for the Coast Survey, that during the full of the moon he was always pretty sure of having a good clear night for observation, if only the common wind-clouds obscured the sky in the early evening; but not when rain-clouds were floating in the atmosphere.

Dr. Emerson said that many years ago he took the position, and had seen no good reason for abandoning it, that apart from gravitation the moon exerted no influence whatever upon the wet and dry changes of the atmosphere.

Pending nominations, Nos. 733, 736, 737, 738, 739, were read and spoken to, and then balloted for. There being no further business, the ballot-boxes were examined and the following gentlemen were declared duly elected members of Society:

Mr. A. Loudon Snowden, Chief Coiner of the U. S. Mint.
Mr. John S. Haines, of Germantown.
Mr. Matthew Huizinga Messchert, of Philadelphia.
Mr. J. Blodgett Britton, of Philadelphia.
Mr. John W. Harden, M. E., of Philadelphia.

Mr. Price submitted the following resolution, which was adopted:

Resolved, That the Treasurer be directed to pay to Henry M. Phillips, Treasurer of the Fairmount Commissioners, such a sum as, with $300 before so paid, shall be equal to half the income of the Michaux Legacy.

And the meeting was adjourned.

Stated Meeting, November 7th, 1873.

Present, 7 members.

Dr. COATES in the Chair.

Letters accepting membership were received from M. Henri de Saussure, dated Genève, October 15, 1873; Mr. M. H. Messchert, dated Douglassville, Berks Co., Pa., October 20, 1873; Mr. J. Blodgett Britton, dated 339 Walnut street, Philadelphia, November 1, 1873; and Mr. A. Loudon Snowden, dated U. S. Mint, Philadelphia, October 22, 1873.

A letter from Mr. George A. Belcourt, prêtre, was read, dated Memramcook, New Brunswick, Canada, October 24, 1873, renewing his correspondence relating to the publication of his Indian Dictionary, the publication of which in the Imperial Printing House at Paris, was stopped by the fall of Napoleon III at Sedan.

Letters of acknowledgment were received from the Belgian Academy, dated Brussels, October 7, July 11, and September 16, 1872, and April 25, 1873 (XIV, i, iii, 85, 86, 86, 87); and the McGill University, dated Montreal, October 14, 1873.

Letters of envoy were received from the Belgian Academy, May 10th, 1873, and the Bureau of Statistics, dated Stockholm, July 7, 1873.

Donations for the Library were received from the Academies of Science at St. Petersburg, Berlin, Copenhagen, Bologna, Rome and Salem; the Institutes at Venice and Milan; the Societies at Moscow, Königsberg, Frankfort, Nüremberg, Lausanne, Geneva, Lyons, Bordeaux, Liège, Copenhagen, Falmouth and Montreal, the Geological Institute at Vienna, Geological Committee at Florence; Geological Societies at London and Glasgow; the Geographical and Anthropological Societies at Paris; the London Geographical, Chemical, Zoological and Antiquarian Societies; the Society of Northern Antiquaries at Copenhagen; the Bureau of Statistics at Stockholm; the Observatory at Brussels; London Nature; the Revue Politique; M. Delesse at Paris, Sig. Capellini at Bologna; M. Rütimeyer at Basil; Dr. Siedenblod at Stockholm; M. Mailly at Bruxelles; the Boston Public Library; Silliman's Journal; the American Chemist; Medical News; Journal of Pharmacy, Penn Monthly and Prof. E. D. Cope, at Philadelphia.

The deaths of two members were announced by the Secretary:

Sir Henry Holland, at London, October 28th, aged 85.
Joseph Saxton, at Washington, October 26th, 1873.

Copies of the First Part of the Society's Transactions, Vol. XV, were laid on the table for inspection, before distribution.

The Secretary read a communication from a friend recently returned from the West, entitled "An Acoustic Phenomenon of the Rocky Mountains."

And the meeting was adjourned.

Stated Meeting, November 21st, 1873.

Present, 11 members.

Vice-President, Mr. FRALEY, in the Chair.

Letters of acknowledgment were received from the Egyptian Institute, dated Alexandria, June 9, 1873;—the Vaterlandische Verein, dated Würtemberg, June 15 (78–80, 82–88), requesting the completion of their set of Proceedings A. P. S. and also Transactions, and promising a full suit of the V. V. publications (on motion, referred to the Publication Committee);—the Schweizerishe Gesellschaft, dated Bonn, 1873 (88); and the Royal Observatory, at Prague, May 9, 1873 (XIV, iii, 87).

Letters of envoy were received from the Batavian Society of Arts, Batavia, November 4, 1872, and the Swiss Society at Bonn.

A letter from the State Historical Society of Wisconsin, dated Madison, November 11, 1873, offering to supply the Library of this Society with State Documents published in the last ten years, and with its own catalogue, was read.

Donations to the Library were announced as received from the Societies at Moscow, Fribourg, Batavia, Nijmegen, and Buffalo; the Chemical, Geological and Antiquarian Societies in London; British Association; London Nature; Radcliffe Observatory; Rev. Samuel Houghton; New York Historical Society; Philadelphia Academy of Natural Sciences, Franklin Institute, American Chemist, and Mr. Eli K. Price

A communication from Prof. Daniel Kirkwood was read, dated Bloomington, Indiana, October 23, 1873, and entitled "The Meteors of January 2d."

Dr. LeConte called the attention of the members present to the report of strange noises in the Rocky Mountains, made in the Journal of Lewis and Clarke, apropos of the communication read at the last meeting.

Mr. Joshua Lyman, of Lenox, Mass., exhibited his improved table-instruments for plotting and draughting with equal accuracy the most accurate field-work of civil engineers. The admiration of experts present was freely expressed.

On motion of Mr. Briggs, Mr. Hilgard, of the Coast Survey, was appointed to prepare an obituary notice of the late Joseph Saxton.

The minutes of the last meeting of the Board of Officers was read.

And the meeting was adjourned.

Stated Meeting, December 5th, 1873.

Present, 13 members.

Vice-President, Mr. Fraley, in the Chair.

A letter acknowledging diploma was received from Prof. Jean Baptiste de Rossi, dated Rome, November 6, 1873.

A circular letter was received from Dr. Leopold Just, dated Carlsruhe in Baden, requesting botanists to forward their memoirs published in 1873, for notice in the Botanischer Jahresbericht.

Donations for the Library were announced from the Royal Prussian Academy, the Geographical Society and Revue Politique at Paris; London Nature; the Royal Astronomical Society; the Chief of the Observatory in the Mauritius; Yale College; Prof. F. B. Hough, of Lowville, N. Y.; the Medical News and Library, Penn Monthly; Dr. Newberry, State Geologist of Ohio; Prof. Worthen, State Geologist of Illinois; and Col. C. G. Forshey, of New Orleans.

The decease of Prof. F. L. Georg von Raumer, at Berlin, June 14, 1873, aged 92, was reported by the Secretary.

Dr. Brinton communicated a vocabulary of the Natchez dialect of the Creek language spoken generally by the tribes of the Gulf States, which he had recently obtained and investigated, including in it the original short vocabularies of Mr. Gallatin and Mr. Duponceau.

The Annual Reports of the Treasurer and Publication Committee were read.

Pending nominations, No. 740 was read.

Dr. LeConte obtained permission to borrow from the Cabinet of the Society, a few small articles of Mexican pottery, under the charge of the Curators.

And the meeting was adjourned.

THE OUTCROP BELT OF THE EAST KENTUCKY COAL FIELD.

(To accompany a Map presented to the American Philosophical Society, June 20th, 1873.)

BY JOSEPH LESLEY,

LATE ASSISTANT ON THE KENTUCKY GEOLOGICAL SURVEY.

Under appointment of David Dale Owen, State Geologist of Kentucky, I began, on the 25th of August, 1858, a Geological and Topographical Survey of the margin of the Eastern Coal Field of the State, to determine its area, and the number, thickness and attitude of its beds of coal and iron ore; and to get a reliable base for a future survey of the whole Eastern Coal Field, as far as to the Virginia line.

The base line of my survey was run upon the common roads of the country; flying side lines, and in some cases closed looped lines, being carried out sideways to the western outcrops wherever necessary.

An admirably constructed odometer was used for measuring distances, and a compass with side-telescope and eccentric target for running courses. Aneroid observations, regularly taken at every station, were checked by clinometric measurements made with a vertical circle attached to the telescope; and also by synchronous observations with a barometer stationary in camp.

The main base line was also carefully leveled for a distance of about two hundred miles with a spirit-level, which was also used on some of the side lines, in order to tie the parts of the work together, and to give the exact datum above tide-water for all principal stations, in view of adopting them as starting points of the contemplated survey of the whole coal field.

The work thus described was continued from September 1, 1858, to November 1, 1859, seven months being passed in field work, and with the following results:

1st. A large contour-line map was made on a scale of three miles to the inch, which has never been published. The original plottings were on a scale of five hundred feet to the inch. This map includes only the ground covered by the survey, and shows the positions of towns, county-line crossings, coal openings and other points of interest, as well as the crossing of the long east and west base line run by S. S. Lyon, Assistant on the State Geological Survey.

2d. The map now published for the first time, to accompany this description, was compiled from the survey sheets of the first-named map, from old maps in the Internal Improvement Office, from railway surveys, and from the old State map.

3d. A base line for future use, extending in a general southwest direction along the strike of the formations, beginning at a point five hundred and ninety-seven feet above tide, close by the town of Grayson, in Carter county, Northeast Kentucky, and extending, by a loop embracing a section covered by the Little Sandy River and its tributaries, to the ridge dividing Carter from Rowan counties; thence, across the east end of Bath county to Jeffersonville, in Montgomery County; thence, to the Red River Iron Works on the edge of Estill county; thence, to the town of Proctor and its coal mines on the Kentucky River; thence, across Owsley county to McKee in Jackson county; thence, to Mt. Vernon in Rock Castle county, and Somerset in Pulaski county; thence, across the Cumberland River at the "lower ford" to Monticello in Wayne county; and thence, to its southern terminus on the Tennessee State-line in Clinton county, at a point on the waters of Wolf River, one thousand and nineteen feet above tide.

4th. The establishment of sixty-two bench marks, showing elevation above tide and above low water in the Ohio River at Catlettsburg.

5th. An unpublished geological section to accompany Map No. 1.

By observations made during the progress of the work, the following points of scientific interest present themselves:

1st. In approaching this coal field from Middle Kentucky, over the lower Silurian formations, one is confronted by a belt of cone-shaped hills having the Devonian black slates in their gently sloping bases, upon which rise steeper slopes of the olive-colored shales and overlying grit stones of the same system. These shales and grit stones together vary in thickness from three hundred and fifty to five hundred and fifty feet, the lower and larger division of the formation having disseminated through it nodular masses of earthy iron ore, giving origin to numerous chalybeate springs; the upper division affording valuable building stone.

Upon the above-named rocks lies the Mountain or Sub-carboniferous Limestone, varying in thickness from seventy feet at the north end of the line to four hundred feet and more at the southern end. This formation is composed of alternating layers of white, gray and buff-colored strata, ranging in quality from argillaceous claystone to the purest plaster limestone. The lowest members of the series hold large dark green flint pebbles, and exhibit traces of galena. Dry valleys and numerous caves distinguish this formation.

Above these limestones lies the Millstone Grit formation (the Conglomerate No. XII of the Pennsylvania Survey) in two members; the lower made up of thin sandstones and shales, enclosing beds of coal and iron ore. This is named the "Sub-conglomerate" member. The upper or "conglomerate" proper consists of a massive, coarse-grained ferruginous sandrock containing pebbles.

The two members of this formation thicken southwestwardly, as do also the rocks of the previously mentioned formations on which they repose, but under different and peculiar conditions.

At Grayson the whole formation measures ninety feet, with the "lowest" coal bed—a mere streak—jammed between its base and the top of the limestone.

At the north fork of Licking River the upper member is one hundred and fifty feet thick; while the lower one is only eight feet thick and contains a well-defined bed of iron ore and a twelve-inch coal-bed.

In Estill county the upper member measures two hundred feet; the lower has also increased to fifty feet, its accompanying ore bed being now workable; and its coal bed measuring twenty-seven inches in thickness.

From this last-named point to the south end of the line at the Tennessee State line the peculiar character of this formation shows itself in a marked manner; its lower member increasing to an average thickness of two hundred and twenty-five feet and containing two workable and three other thin beds of coal and three well-defined horizons of shale containing iron ore; its upper member nowhere exceeding eighty feet in thickness.

The point of sudden change lies geographically between the top of the ridge dividing the Red and Kentucky Rivers and the valley of the Kentucky River itself.

The "lowest" coal bed holds its place throughout the belt; the other sub-conglomerate coals, mentioned above, coming in one by one above it; and in proportion to the constant thickening of the lower member of the formation.

Back from the greatly eroded and boldly-rising wall of the Conglomerate, which always marks the western margin of the East Kentucky coal field, lie, thinly spread over a plateau trenched by ravines, the lowest layers of the Lower Coal Measures proper.

2d. All the formations mentioned above dip to the southeast, making the western side of a wide and shallow synclinal trough.

3d. This great wave, having its axis in a direction N.N.E. and S.S.W., is itself crossed by undulations of no great height and depth, having their axes W.N.W. and E.S.E. Gentle as those undulations were, they were quite sufficient to determine the principal lines of drainage which issue from the mountain country into the plain.

4th. All the formations examined along the base line thicken, and also rise above sea-level, going towards the southwest.

5th. The lowest sub-conglomerate coal varies in thickness, but is persistent throughout the whole extent of the belt surveyed, a distance of about two hundred miles.

6th. Different species of trees mark the outcrops of the different geological formations. The sugar-tree and other maples and the white oak are characteristic of the base of the Devonian "Knobstone" series. Beech and red cedar grow on the sub-carboniferous limestones. Pine, hemlock, laurel and holly possess the conglomerate cliffs and peaks. Chestnut and oak forests cover the shales and sandstones of the great plateau bordered by the conglomerate bluffs.

SYNOPSIS OF THE HISTERIDÆ OF THE UNITED STATES.

By George H. Horn, M.D.

(*Read before the American Philosophical Society, June 20, 1873.*)

It is now twenty-eight years since the revision of the species of this family by Major John Leconte, and it has appeared to me that the time has arrived when a second revision is much needed. All the species known to Marseul have been described by him in his very exhaustive Monograph, and in supplements published from time to time, any new or old species previously unknown to him have been fully described. Numerous species are, however, still unknown in nature to Marseul, and his work is to that extent incomplete. To the large majority of our students, Marseul's Monograph is practically inaccessible, and as it deals with the species of the entire globe, the student of a limited fauna like our own finds it no easy matter to deal with the subject rendered all the more difficult by the vast number of species.

In the preparation of this essay I have availed myself of the cabinet and library of Dr. Leconte, which have at all times been as accessible as if they were my own. At this time I must also record the great kindness of M. de Marseul, who through the kind intercession of M. Aug. Sallé, loaned me many of his unique types for study, and also a similar favor on the part of M. Chevrolat. By these kind acts I have had before me for personal inspection, either the types of the majority of our species or those which are almost types by comparison with the types of authors.

The subdivision of the genera of this family into two tribes appears to me the most natural method, viz.:

Head porrected, mandibles very prominent............HOLOLEPTINI.
Head retracted, bend downward, mandibles not very prominent.. HISTRINI.

Tribe HOLOLEPTINI.

This tribe contains in our fauna but one genus, Hololepta, formed by the union of that genus as recognized by Marseul and *Lionota*, the differences between the two do not appear to be sufficient for their separation.

Hololepta. Payk.

Head prominent, mandibles long produced in the plane of the body, not toothed, inner edge grooved in nearly their entire length for the reception of the maxillæ. Labrum deeply and broadly grooved apex, strongly bent downwards and triangular; on each side slightly notched by the mandibles. Mentum large, entirely corneous, triangularly emarginate in front for the reception of the tip of the labrum. Anterior tibiæ dentate on the inner edge at base, very near the articulation.

By means of these characters the genus Hololepta may be known from all those which follow. The antennæ are inserted under the margin ot the front, and the club has no distinct cavity for its lodgment, being merely received in a slight depression on the under side of the thorax in front of the coxæ.

The following are the species known to us :

Head with supra-orbital stria.
  Elytra without an entire stria ; propygidium smooth at middle ; mentum not carinate ; prosternum moderately prolonged in front but obtuse.
    First and second striæ visible at base only, the second short.. ♂**Yucateca.**
    First and second striæ basal, the second very short, but with an apical portion extending forward to the end of the first stria.............................. ♀***grandis.***
  Elytra with the second stria entire ; mentum with oblique ridge on each side ; prosternal lobe very acute in front ; pygidium and propygidium subopaque, the latter sparsely punctured at middle.
    First elytral stria short, continued by a row of fine punctures, second entire.............................. **cacti.**
Head without supra-orbital stria ; prosternum in front truncate
  Elytra with one stria entire.
    Second stria entire, first short, basal.
      Head without frontal stria ; sides of thorax smooth. **quadridentata.**
      Head with sinuous frontal stria sometimes interrupted at middle ; sides of prothorax coarsely punctured...................................... **vicina.**
    First stria entire, second very short.
      Front not striate, sides of thorax with few punctures.. **lucida.**
  Elytra without entire striæ, first and second striæ short basal, the latter very short.
    Second stria without apical appendicular stria........ **fossularis.**
    Second stria with apical appendix, advancing forward nearly opposite the end of the first................ **populnea.**

H. Yucateca ♂, Mars. Mon. 1853, p. 203, pl. 5, fig. 1 ; 1860, p. 606 ; *grandis* ♀ Mars. l. c. p. 204, pl. 5, fig. 2 ; *princeps* Lec. Proc. Acad. 1859, p. 310.

Mentum transversely slightly concave, anteriorly triangularly emarginate, surface sparsely punctured and without elevated lines. Head with supra-orbital stria and a slight process on each side behind the mandibles. Elytra with two short dorsal striæ, the inner very short and without apical appendix to second ♂, or with apical appendix reaching nearly the tip of the first ♀ : subhumeral deeply impressed extending two-thirds the length of the elytra. Propygidium smooth with fine punctures at the sides only, pygidium coarsely but not densely punctured. Lower crest of hind tibiæ not dentate. Epipleuræ unistriate. Length .36–.40* inch; 9–10 mm.

The above synonymy is that of Marseul, confirmed by a comparison with a specimen from Mexico.

The species has a wide distribution, occurring from Cajon Pass, California, to Camp Grant, Arizona.

H. cacti. Lec. Ann. Lyc. V., p. 162; Mars. Mon. 1857, p. 400, pl. 10, fig. 5.

Mentum coarsely punctured, triangularly emarginate, with an elevated line extending obliquely from the hind angles to the middle of the emargination on each side. Prosterum in front acute. Supra-orbital stria as in the preceding, front on each side near the base of mandibles with rudimental frontal stria. First dorsal stria short, not reaching the middle; second entire, subhumeral moderately deep extending from apex to basal fourth. Propygidium shining at middle, opaque at the sides and apex, and coarsely and sparsely punctured; pygidium opaque, sparsely and equally punctured. Hind tibiæ as in the preceding species. Length, .20–.30 inch; 5–7.5 mm.

Occurs with the preceding. My specimens of both were taken in decomposing Cereus.

H. quadridentata, Fab. Ent. Syst. I., p. 74; Payk. Mon. p. 109, pl. 9, fig. 4; Mars. Mon. 1853, p. 212, pl. 5, fig. 10; 1860, p. 608; *platysma*, Er. Jahr. 1834, p. 95.

Mentum slightly concave transversely, sparsely punctured and with feeble oblique line, in front triangularly emarginate. Head without supra-orbital stria. Elytra with two dorsal stria, first short extending one-third, second entire, slightly arcuate, subhumeral moderately deep, extending three-fourths to base. Propygidium shining coarsely punctured at the sides, pygidium opaque, coarsely and equally punctured. Hind tibiæ with the lower and upper crests dentate. Epipleuræ smooth unistriate. Length .16–.20 inch, 4–5 mm.

Occurs in the Southern States, West Indies and South America.

In the males the anterior angle of the thorax has a moderately deep fossa; the females are devoid of it.

H. vicina, Lec. Ann. Lyc. V., p. 163.

Head without supra-orbital stria, a bisinuate frontal stria. Mentum transversely concave, shining, sparsely punctured. Thorax punctured at the sides. Elytra with the second dorsal entire, first short, scarcely one-third, subhumeral four-fifths the length of the elytra. Propygidium coarsely, and very sparsely punctured: pygidium cribrately punctured. Lower hind tibial crest not dentate. Length .20 inch; 5 mm.

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*All measurements in the present paper are made from the anterior margin of the thorax to the tip of the elytral suture; the same method is used by Marseul.

The first dorsal has sometimes a short apical appendix.

The sexes are marked as in the preceding species.

Collected near San Diego, California.

H. lucida, Lec. Bost. Journ. V., p. 37, pl. 1, fig. 2; Mars. Mon. 1853, p. 177, pl. 4, fig. 18.

Mentum transversely concave, smooth, triangularly emarginate in front. Thorax punctured at the sides, marginal stria entire. Elytra with first dorsal entire, second short basal, rarely with a very short apical appendix, third punctiform, basal, subhumeral deep abbreviated at both ends. Propygidium smooth at middle, coarsely punctured at the sides and apex, pygidium coarsely and equally punctured. Hind tibiæ with upper crest alone dentate. Length .20 inch; 5 mm.

Occurs in the Middle States and Kansas.

H. fossularis ♂, Say, Journ. Acad. 1825, p. 47; Lec. Bost., Journ. V., p. 37, pl. 1, fig. 1; Mars. Mon. 1853, p. 147, pl. 4, fig. 5; *æqualis* ♀, Say, loc. cit.

Resembles the preceding, but differs in the striation of the elytra. The first stria is short, not larger than a fourth of the elytra, the second shorter, and the third merely a trace, subhumeral deep. Otherwise as in *lucida*. Length .20 inch; 5 mm.

Occurs with the preceding.

H. populnea, Lec. Ann. Lyc. V., p. 163; Mars. Mon. 1860, p. 592, pl. 11, fig. 5.

Mentum as in *lucida*. Thorax very sparsely punctured at the sides. Elytra with first dorsal short, scarcely a third the length of the elytra; second shorter, and with an apical appendix frequently advancing opposite the tip of the first. Propygidium smooth, at sides very sparsely punctured, pygidium sparsely punctured. Hind tibiæ as in *lucida*. Length .18 inch; .45 mm.

Occurs in Arizona, between the layers of dead Cottonwood bark.

Tribe HISTRINI.

This tribe may be again subdivided:

Prosternum distinctly lobed in front........................ Histrini.
Prosternum not lobed in front........................ Saprini.

The prosternal lobe appears to be a piece distinct from the prosternum, and between the two the suture is more or less distinct. In the majority of cases the lobe is provided with a lateral extension, which joins the prothoracic epipleuræ, and when it exists is called the pectoral plate. In every case when the pectoral plate exists it forms part of the boundary of the antennal fossa, and usually renders the latter partially invisible from beneath.

The subtribes as thus defined are essentially the same as in the "Classification" of Dr. Leconte. *Bacanius* has been removed from the first and placed near *Acritus* in the second, the reasons for which will be given in the proper place. *Tribalus* has the prosternal lobe short, but its lateral prolongations form the lower boundary of the antennal fossa, a structure which cannot exist in the second sub-tribe.

Sub-Tribe HISTRINI.

This sub-tribe contains in our fauna the larger number of genera and species.

The genera are thus distinguished :

Antennal cavities at the anterior angle of the thorax, usually closed beneath more or less entirely by the pectoral plate, but open in front.
Antennal club more or less oval, pubescent, and usually, distinctly annulated.
Mandibles moderately prominent, upper edge rounded, not clasping the epistoma, labrum trapezoidal.
Antennal club broadly oval, distinctly annulated, elytra never acutely margined................ HISTER.
Antennal club elongate oval, apparently solid but pubescent, elytra acutely margined........... TRIBALISTER.
Mandibles retracted, upper edge acute, at base clasping the epistoma, labrum short, very transverse.
Prosternum broad, lobe short, elytra scarcely striate, form ovate......................... TRIBALUS.
Prosternum moderate, lobe moderately prolonged, elytra striate, form oblong.................... EPIERUS.
Antennal club obconical, solid, glabrous.
Prosternal lobe thick, horizontal. Epistoma truncate, labrum normal.......................... HETÆRIUS.
Prosternal lobe thin, broad, deflexed. Epistoma bifurcate, labrum small...................... ECHINODES.
Antennal cavities slightly behind the anterior angles, open beneath, closed in front by the thickening of the inflexed portion of prothorax.
Antennæ frontal.................................... ONTHOPHILUS.
Antennal cavities at the middle of the thorax beneath, in front of the outer portion of the coxæ, prosternal plate not prolonged laterally.
Anterior tibiæ with moderately large terminal spur...
Anterior tibiæ dilated, middle and hind tibiæ slender.. PAROMALUS.
Tibiæ all dilated.................................. DENDROPHILUS.
Anterior tibiæ with small terminal spur. Anterior tibiæ slightly dilated, middle and hind tibiæ slender.. ANAPLEUS.

Many species of Hister (*arcuatus, lævipes, interruptus, etc.*), have no proper pectoral plate, and the antennal cavity is entirely uncovered. This character cannot be made use of in a systematic manner, as the transition is so gradual from one form to the other.

In the last three genera, the funicle of the antennæ when at rest passes through an incisure between the prosternum proper and the episternum. The prosternal lobe in Dendrophilus is broader and shorter than in Paromalus.

HISTER, Linn.

For convenience of study this genus may be divided into the following sub-genera, some of which have been considered sufficiently well founded as to have been retained as genera. In the scheme published by Dr. Leconte, Proc. Acad. 1852, p. 38, they have all been united under the name Hister, subsequently, Class Col. N. A. p. 76, *Phelister* alone was separated, at the same time doubts were expressed as to the propriety of the course.

- Anterior tibiæ with the tarsal groove badly defined, straight.
  - Internal marginal thoracic stria more or less distinct, always entire; mesosternum emarginate or truncate at apex.
    - Hind tibiæ broad at base, with a single row of spines.. *Psiloscelis.*
    - Hind tibiæ narrow at base, two rows of spines.
      - Elytral striæ obliterated, surface opaque, punctured with smooth flattened tubercles........ *Margarinotus.*
      - Elytra striate................................ *Hister.*
  - Internal marginal thoracic stria entirely absent; mesosternum more or less produced in front, prosternum at tip emarginate.
    - Hind tibiæ with two rows of spines; elytra striate. *Phelister.*
- Anterior tibiæ with tarsal groove well defined; internal marginal thoracic stria entirely absent. Middle and hind tibiæ dentate.
  - Anterior tibiæ without tooth on inner margin; prosternum at apex flattened and without marginal line.. *Platysoma.*
  - Anterior tibiæ with a small internal tooth near the base; prosternum convex and with marginal line... *Cylistix.*

Sub-genus *Psiloscelis.*

Thorax with two marginal striæ closely approximated, the outer very close to the margin. Hind tibiæ scarcely narrower at base than apex, strongly compressed, and with a single row of spines, anterior tibiæ feebly dentate. Epipleuræ bistriate. Elytra with subhumeral stria abbreviated at apex. Surface densely punctured.

Prosternum with marginal line at tip; surface opaque, foveolato-punctate	planipes.
Prosternum not margined; surface moderately shining, coarsely punctured	subopacus.

H. planipes, Lec. Proc. Acad. 1852, p. 39; *Harrisii* Lec. Bost. Journ. V., 1845, p. 14, pl. 1, fig. 11; Mars. Monog. 1853, p. 542, pl. 16, fig. 1.

Black, opaque, thorax less opaque than the elytra. Head densely punctured, frontal stria well marked. Thorax densely and equally punctured. Elytra opaque, foveolato-punctate, with six dorsal striæ, of which four are entire, the fifth and sutural approaching at base and obliterated, humeral stria very short, subhumeral moderately impressed obliterated at apex. Pygidium and propygidium densely foveolato-punctate, the latter less densely than the former. Body beneath more shining than above, foveolato-punctate. Prosternum with marginal line at apex. Legs shining, sparsely punctate. Length .26 inch; 6.5 mm.

Occurs from Massachusetts to Georgia.

H. subopacus, Lec. New Species, 1863, p. 60.

Subopaque. Head densely punctured, frontal stria deeply impressed. Thorax coarsely and densely punctured, more densely at the sides. Elytra coarsely and rather densely punctured, punctures of sutural interval fine; each elytron with six dorsal striæ, the sutural and fifth abbreviated at base, humeral stria very short, subhumeral moderately impressed, abbreviated at base and continued at apex, by a row of coarse punctures. Propygidium and pygidium coarsely punctured, the latter more densely. Body beneath more shining than above, coarsely punctured at the sides, more finely and less densely at middle. Femora sparsely punctate. Prosternum without marginal line at tip. Length .24 inch; 6 mm.

Narrower, less convex and less opaque than *planipes*, and readily known by the absence of the marginal line at apex of prosternum.

Two specimens are known, collected in Nebraska and Vancouver.

Sub-genus *Margarinotus.*

Marginal striæ of thorax confused, scarcely visible, the inner very distant from the margin. Hind tibiæ slender at base, biseriately spinulose, anterior five dentate, the upper tooth small. Elytra with the intervals of the striæ with smooth sub-depressed tubercles, striæ almost entirely obliterated. Epipleuræ of elytra either unistriate (*guttifer*) or not striate (*scaber*).

The only character separating *Margarinotus* from *Hister* is the sculpture of the surface of the body; and not recognizing this to have any great importance, I have united the former genus to the latter.

H. guttifer, Horn. Proc. Ent. Soc. 1862, p. 167; Trans. Ent. Soc. 1870, pl. 1, fig. 5.

As the sculpture of this insect has been as nearly produced as the varying tendencies of the individuals admit, nothing further need here be added. Between the punctures, however, the striæ, in a partially obliterated condition appear, and at the sides an almost entire subhumeral appears. Thorax without external marginal stria, inner stria nearly obliterated and very distant from the margin. Epipleuræ of elytra unistrate. Length .18–.20 inch ; 4.5–5 mm.

Occurs along the eastern base of the Rocky Mountains, from Nebraska to Texas.

The only other species of the sub-genus is the *scaber* of Southern Europe. The two differ primarily in the surface sculpture particularly that of the thorax, and which can be best seen by a comparison of the figures of the two. The outer marginal striæ of the thorax do not exist in *guttifer*, two are said to exist in *scaber*, of which however one only is at all distinct. The subhumeral stria is nearly obliterated in *scaber* and almost entire and very distinctly impressed in our own. The epipleuræ are punctured and not striate in the former and very distinctly unistriate in the latter. The under surface of the body is coarsely punctured in the former and nearly smooth at middle in the latter, and the femora of of each species partake of the sculpture of the under surface. Both species are broadly oval.

Sub-genus *Hister*.

Thorax with two lateral marginal striæ and occasionally with the evidences of a third. Hind tibiæ narrower at base than at apex and biseriately spinulose and rarely with the spinules somewhat confused, anterior tibiæ variable, either bi-, tri- or multidentate. Elytra always striate. Tarsal groove of anterior tibiæ badly defined.

The sub-genus Hister as above restricted contains a very large number of species which for convenience may be divided into groups.

- Margin of thorax ciliate, Antennal cavities shallow.
  - Outer marginal thoracic stria entire, anterior tibiæ dentate.. **Gr. *arcuatus*.**
  - Outer marginal stria abbreviated, anterior tibiæ not dentate.. **Gr. *laevipes*.**
- Margin of thorax not ciliate, Antennal cavities deep.
  - Mesosternum emarginate.
    - Subhumeral stria entire.
      - Elytra 3-striate ; outer thoracic stria very close to margin.. **Gr. *sexstriatus*.**
      - Elytra 4-striate ; outer thoracic stria often absent or when present distant from margin.
        - Outer thoracic stria entire........................ **Gr. *merdarius*.**
        - Outer thoracic stria much abbreviated or absent. **Gr. *foedatus*.**
    - Subhumeral stria interrupted, often entirely obsolete.
      - Tibiæ serrulate.................................. **Gr. *abbreviatus*.**
      - Tibiæ tridentate.................................. **Gr. *depurator*.**
  - Mesosternum truncate (*Atholus*, Thoms.)
    - Epipleuræ very narrow, unistriate................ **Gr. *bimaculatus*.**
    - Epipleuræ bistriate and broader.................. **Gr. *americanus*.**

Owing to the difference which have resulted, by the adoption of the above method of subdivision, the system of numbering the groups has not been adopted, and in lieu thereof a typical and usually a common species has been selected as the representative of each group, in order that the groups here made might not be confounded with those of Marseul and Dr. Leconte.

Group *Arcuatus.*

Species of robust form. Thorax with entire margin ciliate. Antennal cavities shallow. Anterior tibiæ usually bidentate.

The following species compose this group :

Thorax with apical intermediate confused stria.
Elytra with three dorsals and a sutural stria.......... arcuatus.
Elytra with three dorsals only........................ sellatus.
Thorax with two thoracic striæ only.
Anterior tibiæ bidentate.
Prosternal lobe acute............................ Gloveri.
Prosternal lobe rounded at apex.
Elytra with no subhumeral stria.
Hind tibiæ with outer row of spinules densely placed ; thorax densely fimbriate............ instratus.
Hind tibiæ sparsely spinulose ; thorax densely fimbriate.................................. biplagiatus.
Elytra with apical subhumeral, usually deeply impressed...................................... Ulkei.
Anterior tibiæ tridentate apical tooth divided.
No subhumeral stria......................... lucanus.

H. arcuatus, Say. Journ. Acad. 1825, p. 34 ; Mars. Monog. 1854, p. 258, pl. 7, fig. 62.

External and internal thoracic striæ entire gradually approaching at base, and between them at apex a confused intermediate stria extending usually beyond the middle. Three entire dorsal striæ to the elytra, a short basal fourth, and a sutural extending in front of middle. Subhumeral feeble at apex, humeral appendix usually deeper. Elytra black with arcuate red space at middle of each. Hind tibiæ with spinules confusedly arranged. Anterior femora brownish, middle and hind femora red tipped at each end with black. Length .26 inch ; 6.5 mm.

Occurs in the Middle States, but not common.

H. sellatus, Lec. Pacif. R. R. Rep. 1857, p. 37 ; *Senevillei,* Mars. Mon. 1857, p. 422, pl. 10, fig. 119.

More elongate than the preceding, and with similar thoracic striation. The elytra have three striæ and a mere rudiment of a fourth at base, the sutural is entirely obsolete. The subhumeral stria is entirely wanting, with rarely but a trace represented by a few punctures, the humeral appendix being entirely wanting.. The hind tibiæ are spinulose in three oblique series. The elytra are entirely red with a narrow apical margin, and sub-scutellar trapezoidal spot black. Legs entirely black. Length .22 inch; 5.5 mm.

Occurs in California and Oregon.

H. Gloveri, Horn, Trans. Am. Ent. Soc. 1870, p. 134.

Form robust as in *arcuatus*. Thorax with two entire striæ. Elytra with three entire dorsal and a short sutural stria. Subhumeral stria obsolete replaced by a few punctures, humeral appendix short, moderately impressed. Prosternal lobe acutely produced in front. Hind tibiæ biseriately spinulose. Legs piceous. Color variable. Length .22–.26 inch; 6.5 mm.

From all the species of the group this may be once known by the very acute prosternal lobe. In the typical specimen the color is entirely black, while a variety in the cabinet of Dr. Leconte has the elytra colored as in *biplagiatus*, but with less distinctness of definition between the black and red portions.

Kansas and Indian Territory.

H. instratus, Lec. Col. Kansas, 1859, p. 7.

Similar in form to *sellatus*. Thorax with lateral striæ both entire and with no apical intermediate striæ. Elytra with three entire dorsal striæ, a rudiment of a fourth and moderately long sutural, subhumeral stria wanting or with merely a faint trace of a short humeral appendix. Elytra colored as in *sellatus*. Legs colored as in *arcuatus*. Hind tibiæ biseriately spinulose. Length .22 inch; 5.5 mm.

His species is very closely allied to *biplagiatus*, Lec., but differs by its more robust form, its more distinctly fimbriate thorax, and by the outer row of spinules of the hind tibiæ being composed of spinules very closely approximated. In the specimen before me there is a very short appendicular stria under the humeral prominence very feebly impressed, which never exists in any *biplagiatus* that I have seen. From *Gloveri* it differs in having the tip of the prosternal lobe broadly rounded and not acute.

Occurs in Kansas.

H. biplagiatus, Lec. Bost. Journ. V., p. 55, pl. 3, fig. 4; Mars. Mon., 1854, p. 552, pl. 9, fig. 119.

There is no trace whatever of subhumeral stria or humeral appendix in any specimens before me. There are three entire dorsal striæ and rarely a trace of the fourth at base. The sutural frequently extends one-half to base, usually much shorter. Thorax sparsely fimbriate, hind tibiæ distantly spinulose, legs black or piceous. Length .20 inch; 5 mm.

Abundantly distributed from the Middle States to Georgia, and westward to Kansas.

H. Ulkei, Horn, Trans. Am. Ent. Soc., 1870, p. 134; *arizonæ*, Horn, l. c., p. 135.

Resembles the preceding in form and coloration, and differs in the presence of an apical subhumeral stria extending two-thirds to base, close to the first dorsal, and rarely with a short subhumeral appendix. There is also a fourth dorsal at apex of varying length, sometimes extending in front of middle, and more rarely the traces of a fifth. The hind tibiæ agree with those of *biplagiatus*. Legs black or piceous. Length .16–.22 inch; 4–5.5 mm.

Occurs in Kansas, Nebraska, Colorado and Arizona.

H. lucanus, n. sp.

Thorax sparsely fimbriate, lateral striæ two, entire, at base coarsely punctured, punctures more numerous and coarser toward the sides. Elytra red with sides, apex and trapezoidal scutellar spot black, three entire dorsal striæ and a sutural extending in front of middle. Epipleuræ bistriate. Anterior tibiæ tridentate, the upper tooth feeble, the apical bifid. Hind tibiæ biseriately spinulose. Body beneath and legs black and shining. Length .12 inch; 3 mm.

Resembles *biplagiatus* but easily known by the form of the anterior tibiæ. The subhumeral stria is entirely wanting. One specimen, Cape San Lucas, Lower California.

Group *Lævipes*.

Anterior tibiæ of elongate triangular, outer margin straight, not dentate. Thorax bistriate, outer stria close to the margin and somewhat abbreviated. Epipleuræ bistriate, subhumeral short, apical. Antennal cavities shallow.

H. lævipes, Germ., Ins. spec. nov. p. 87; Lec. Bost. Journ. V., p. 50, pl. 1, fig. 7; Mars. Mon., 1854, p. 233, pl. 7, fig. 49.

Elytra with three entire dorsal striæ, a very short basal fourth and an almost entire sutural. Subhumeral stria apical, close to the first dorsal and half its length. Propygidium sparsely punctured at the sides, smooth at middle, pygidium convex smooth with a very few punctures at the sides. Legs black, smooth. Length .14–.18 inch; 3.5–4.5 mm.

Occurs from Pennsylvania to Georgia.

This species is the only one in our fauna belonging to this group, and may be distinguished from every other by the simple anterior tibiæ.

Group *Sexstriatus*.

Thorax bistriate, outer stria close to the margin, and abbreviated at each end. Anterior tibiæ quadridenticulate, apical tooth bifid. Antennal cavities deep, partially enclosed by the prolongation of the sides of the prosternal lobe. Hind tibiæ subtridentate.

H. sexstriatus, Lec. Ann. Lyc. V., p. 163; Mars. Mon., 1854, p. 290, pl. 8, fig. 86.

Anterior angles of thorax sparsely and finely punctured, more coarsely punctured along a narrow basal space especially at the sides. Elytra with three entire dorsal striæ, sutural obsolete, subhumeral entire and straight. Pygidium and propygidium coarsely but not densely punctured, the latter the more sparsely. Length .22–.28 inch ; 5.5–7 mm.

Occurs in California.

Group *Merdarius*.

Thorax bistriate, outer stria entire and as distant from the margin as from the inner stria, this latter usually shorter than the outer. Anterior tibiæ quadridentate, hind tibiæ biseriately spinulose. Elytra with four entire striæ. Epipleuræ unistriate, subhumeral stria entire. Antennal cavities deep.

Surface above, sparsely punctured........................ **Harrisii.**
Surface smooth.
  Apical tooth of anterior tibiæ more prominent than the second... **merdarius.**
  Apical tooth much less prominent than the second.
    Sutural stria long extending in front of middle...... { **interruptus.** **stygicus.**
    Sutural stria very short, apical...................... **immunis.**

H. Harrisii, Kby. Fauna Bor. Am. IV., p. 124 ; Lec. Bost. Journ. V., p. 49, pl. II, fig. 5 ; Mars. Mon., 1854, p. 299, pl. 8, fig. 92.

Surface sparsely and equally punctured. Anterior tibiæ quadridentate, apical tooth shorter than second. Thorax bistriate, outer stria entire and arcuate at base, inner slightly shorter than the outer, and confused at basal end. Elytra with four entire striæ, fifth extending to middle, sutural longer than the fifth, subhumeral entire. Propygidium and pygidium coarsely and rather densely punctured and subopaque. Length .16–.20 inch ; 4–5 mm.

Occurs from the Middle States to Georgia.

H. merdarius, Hoffm. Ent. Hefte, 1, p. 39, pl. 1, fig. 3 ; Lec. Bost. Journ. V., p. 47, pl. 2, fig. 1 ; Mars. Mon., 1854, p. 297, pl. 8, fig. 91 ; *memnonius*, Say. Journ. Acad., 1825, p. 32.

Sides of thorax with a few sparsely placed punctures, bistriate, outer stria entire and straight, inner somewhat sinuous, frequently slightly shorter than the outer. Elytra with three entire striæ, fourth slightly abbreviated at base, fifth and sutural nearly equal, extending to the middle, subhumeral entire nearly straight. Anterior tibiæ quadridentate, apical tooth more prominent than the second, and slightly notched at the tip. Propygidium sparsely punctured, pygidium more densely and equally punctured. Length .20–.22 inch ; 5–5.5 mm.

Occurs in the Middle States, is common in Europe.

H. interruptus. Beauv. Ins. 180, pl. 66, fig. 8 ; Mars. Mon., 1854, p. 295, pl. 10, fig. 90 ; *obtusatus*, Harris. Trans. Nat. Hist. Soc. Hartford, No. 1 ; Lec. Bost. Journ. V., p. 47, pl. 2, fig. 2.

Thorax at sides smooth, bistriate, striæ entire, equal, straight. Elytra with three entire striæ, fourth slightly abbreviated at base, fifth short, apical, sutural extending in front of middle, subhumeral entire. Propygidium coarsely but sparsely punctured, pygidium more finely and sparsely punctured, nearly smooth at apex. Anterior tibiæ sub-5-dentate, apical tooth shorter than second and slightly bifid. Length .20–.26 inch; 5–6.5 mm.

Middle and Western States, common.

H. stygicus, Lec. Bost. Journ. V., p. 48, pl. 2, fig. 4; Mars. Mon., 1854, p. 301, pl. 9, fig. 94.

There are absolutely no characters on which to separate this species from *interruptus* excepting the following:

Species much smaller, form more broadly oval, thoracic striæ entire, parallel and equi-distant from each other, and from the margin. Elytral striæ exactly as in *interruptus*. Propygidium coarsely but very sparsely punctulate, pygidium shining very minutely and sparsely punctulate. Length .10 inch; 2.5 mm.

The species is described as having four entire striæ, the fourth stria is abbreviated at base. Marseul mentions a basal arc opposite the fifth stria; this may or may not be present in any species of this group. The head is said to have an impressed point at middle of front; of the two typical specimens one has it, the other has not.

Two specimens from Georgia.

H. immunis, Er. Jahrbuch, 1834, p, 143.

Sides of thorax bistriate, striæ entire, parallel and straight. Elytra with three entire striæ, fourth slightly abbreviated at base, fifth very short, apical, sutural either very short or entirely obsolete, subhumeral entire. Propygidium coarsely and evenly punctured, pygidium more finely punctured especially at apex. Anterior tibiæ sub-5-dentate, apical tooth shorter. Length .20 inch; 5 mm.

Occurs in the Middle States, and also in California.

Group *Foedatus.*

Inner thoracic stria entire or very nearly so, outer either entirely absent or very much abbreviated. Anterior tibiæ multidentate.

Thoracic margin thickened, inner stria entire; epipleuræ unistriate..marginicollis.
External thoracic stria entirely obliterated.
  Thoracic margin not thickened.
    Stria posteriorly abbreviated; epipleuræ unistrate.... cognatus.
    Stria entire; epipleuræ bistriate..................... remotus.
External thoracic visible, usually very short, rarely half the length of the inner.
  Inner stria slightly abbreviated at tip; epipleuræ unistriate.. foedatus.

H. marginicollis, Lec. Bost. Journ. V., p. 58, pl. 3, fig. 11; Mars. Mon., 1854, p. 542, pl. 9, fig. 113.

Surface of thorax minutely punctulate, at sides sparsely punctured near the base, inner stria entire, margin convex. Elytra with three entire dorsal striæ, fourth abbreviated at base, extending slightly in front of middle, fifth very short, apical, sutural as long as the fourth, subhumeral entire. Epipleuræ unistriate. Pygidium and propygidium sparsely and rather coarsely punctured. Anterior tibiæ 5-dentate, teeth acute. Length .18 inch; 4.5 mm.

Middle States rare. Marginal line of prosternal lobe distinct, entire.

H. cognatus, Lec. Bost. Journ. V., p. 58, pl. 3, fig. 10; Mars. Mon., 1857, p. 421, pl. 10, fig. 111.

Lateral stria of thorax abbreviated at tip, confused by punctures which also extend forward on its inner side. Elytra with three entire dorsal striæ, fourth nearly entire, fifth short apical, sutural rarely extending in front of middle, subhumeral entire. Pygidium and propygidium coarsely and evenly, but not densely punctured. Anterior tibiæ sub-5-dentate, apical tooth very small. Length .10–.14 inch; 2.5–3.5 mm.

Closely resembles *foedatus*, but the absence of an exterior thoracic stria as well as the margined prosternal lobe at once distinguish it. Two specimens are before me in which the punctures within the inner stria of the thorax are entirely absent, and the stria longer, but I feel unwilling to separate them on these characters without a larger series of specimens.

Middle States, Canada, Illinois, Wisconsin. Not rare.

H. remotus, Lec. Proc. Acad., 1859. p. 70.

Sides of thorax near the stria with few punctures, stria distant from the margin, entire and slightly sinuous. Elytra with three entire dorsal striæ, fourth slightly abbreviated at base, fifth one-third the length of the elytra, sutural somewhat longer, subhumeral entire. Propygidium coarsely and sparsely, pygidium more densely punctured. Prosternal lobe with marginal line distinct. Anterior tibiæ pluridentate. Length .16 inch: 4 mm.

This species is the most oblong of any in the group.

Occurs at Fort Tejon, California.

H. foedatus, Lec. Bost. Journ. V., p. 50, pl. 2, fig. 8; Mars. Mon., 1854, p. 292, pl. 8, fig. 88.

Outer marginal stria of thorax usually forming a short arc near the anterior angle, rarely extending half the length of the thorax, inner stria usually abbreviated at tip. Disc of thorax very minutely punctulate, at the sides more distinctly punctured near the stria. Elytra with three entire striæ, fourth slightly abbreviated; fifth one-third, sutural one-half the length of the elytra, subhumeral entire. Pygidium and propygidium densely punctured. Anterior tibiæ pluridentate. Length .14–.22 inch; 3.5–5.5 mm.

The prosternal lobe has the marginal line entirely obliterated in the large majority of specimens. A variety occurs in the cabinet of Dr. Leconte, bearing the manuscript name *proximus* in which the sides of the thorax are scarcely at all punctured, the outer stria at its maximum, and the prosternal lobe with the marginal line distinct. I feel unwilling to separate it, however, as the characters are those which are the most likely to be variable, and transitional forms in one or other character constantly appear. A variety occurs in Oregon and Vancouver with the outer thoracic stria half the length of the inner, the prosternum not margined, and the form approaching *remotus*. These have been associated with the latter species in cabinets, but the outer thoracic stria and the unistrate epipleuræ at once distinguish it.

Occurs from Canada to Georgia, and westward to Vancouver and Oregon.

Group *Abbreviatus*.

Subhumeral stria interrupted, often very short or even entirely absent. Anterior tibiæ serrulate or mutic. This group and the following may be distinguished from the three which immediately precede by the interrupted or even entirely absent subhumeral stria. This stria when present may be represented by the basal or the apical portion, sometimes both are present and are usually separated; when they are united the union is produced by the extension of a few punctures from the humeral portion, which do not however join the end of the apical portion. The stria never presents that straight continuous form of the preceding groups. The subhumeral in the preceding groups is always the external, and is more distant at apex from the first dorsal than the latter is from the second. The subhumeral in this and the next group is internal, and nearer the first dorsal than the latter is from the second, and when the humeral appendix forms an union with the apical portion, as above indicated, the basal tip of the latter always passes beyond this point in the direction of the fine oblique humeral stria, which is really the continuation of an internal subhumeral.

The species of this group have the anterior tibiæ sometimes multidenticulate, usually serrulate and rarely nearly mutic, the serrulations being composed of spinules, and are independent of any denticulation of the tibia itself.

Subhumeral stria apical, deeply impressed.
  Outer margin of anterior tibiæ regularly arcuate, minutely serrulate.
    Front flat; anterior tibiæ multidenticulate............. cœnosus.
    Front with a moderate impression; anterior tibiæ finely quadridentate...................................... punctifer.
  Outer margin of anterior tibiæ sinuate and multidentate.
    Subhumeral with humeral appendicular stria...........abbreviatus.
Subhumeral entirely obliterated or with mere trace.
  Elytra 3-striate, outer thoracic very short or absent.
    Anterior tibiæ finely serrulate or mutic; outer thoracic stria visible at apex............................ civilis.

H. cœnosus, Er. Jahrb., 1834, p. 154 ; Mars. Mon., 1854, p. 276, pl. 8, fig, 76 ; *decisus*, Lec. Bost. Journ. V., p. 51, pl. 2, fig. 10 ; *repletus*, Lec. loc. cit. p. 49, pl. 2, fig. 6.

Thorax bistriate, inner stria entire, outer abbreviated but extending beyond the middle, and between the two stria at apex are either a few punctures or a very short stria. Front not impressed. Elytra with four entire striæ, a fifth extending to middle and the sutural longer, subhumeral at apex deeply impressed, and with a very short feebly impressed humeral appendix. Epipleuræ bistriate. Propygidium very sparsely punctured, pygidium very minutely punctulate, and with a few coarser punctures near the sides. Anterior tibiæ with the outer margin regularly arcuate, minutely denticulate. Hind tibiæ biseriately spinulose. Length .18–.22 inch ; 4.5–5.5 mm.

I cannot find that *repletus* differs except in having the fifth dorsal stria a trifle longer.

Occurs from the Gulf States to Mexico.

H. punctifer, Payk. Mon. p. 25, pl. 4, fig. 1, Lec. Bost. Journ. V., p. 51, pl. 2, fig. 9 ; Mars. Mon., 1854, p. 265, pl. 8. fig. 67.

The surface sculpture of this species is precisely that of *cœnosus*, and differs as follows : Head with a shallow fovea. Outer thoracic stria not extending to middle. Humeral appendicular stria short deeply impressed. Propygidium on each side with a shallow impression. Anterior tibiæ feebly quadridentate. Length .22 inch ; 5.5 mm.

One specimen said to have been found in the Middle States, corresponding exactly with Marseul's description, is before me.

H. thoracicus, Payk. Mon. p. 20, pl. 2, fig. 5.

From the description this species appears to be allied to the preceding. It is, however, entirely unknown, either to us or Marseul.

H. abbreviatus, Fab. Syst. Ent. p. 53 ; Lec. Bost. Journ. V., p. 52, pl. 2, fig. 11 ; Mars. Mon., 1854, p. 283, pl. 8, fig. 82 ; *subhemisphericus*, Beauv. Ins. p. 180, pl. 6, fig. 7 ; *bifidus*, Say, Journ. Acad. 1825, p. 34 : Lec. loc. cit. pl. 2, fig. 12 ; Mars. loc. cit. p. 284, pl. 8, fig. 83.

Thorax at sides bistriate, outer stria extending to middle, inner entire. Elytra with four entire striæ coarsely punctured, fifth short, apical, sutural half the length of the elytra. Subhumeral at apex deeply impressed, with humeral appendix extending to base, also deeply impressed, and joining the apical portion behind its tip. Propygidium coarsely and sparsely punctured, pygidium nearly impunctate. Anterior tibiæ feebly 4-dentate apical tooth bifid. Length .12–.20 inch ; 3–5 mm.

This species varies somewhat in the length of the outer thoracic striæ, as well as in the depth of the elytral striæ. One specimen before me has a mere trace of an external subhumeral near the apex.

Middle States to Georgia, and westward to Montana and Kansas.

H. civilis, Lec. Bost. Journ. V., p. 55, pl. 3, fig. 5 ; Mars. Mon.. 1854. p. 570, pl. 9. fig. 134.

Inner thoracic stria entire, outer very short, forming merely an arc at the anterior angle. Elytra with three entire dorsal striæ, fourth existing merely as a trace at apex, sutural very short, subhumeral entirely absent. Propygidium coarsely and very sparsely punctured, pygidium more finely punctured and nearly smooth at apex. Anterior tibiæ very finely denticulate, often almost entirely mutic. Length .16 inch ; 4 mm.

By the entire absence of subhumeral stria, as well as by the nearly mutic anterior tibiæ this species is abundantly distinguished from any in the group.

Occurs from the Middle States to Illinois.

Group *Depurator*.

In this group the anterior tibiæ are denticulate, the teeth being formed by processes of the tibiæ itself, and not as in the preceding group merely spinules attached, so to speak, to the outer edge of the tibia.

The species are as follows :

Thorax unistriate ; elytra tristriate.
Epipleuræ unistriate ; anterior tibiæ 4-dentate..........semisculptus.
Epipleuræ bistriate ; anterior tibiæ 3-dentate.............. dispar.
Thorax bistriate.
Elytra tristriate.
Apex of prosternal lobe truncate, on each side slightly prominent...................................... furtivus.
Apex of prosternal lobe rounded, normal.
Epipleuræ tristriate, fourth dorsal basal rudimentary ; no subhumeral............................. incertus.
Epipleuræ bistriate, fourth dorsal wanting or apical.
Apical subhumeral moderately impressed, elytra black...................................... depurator.
Subhumeral entirely wanting, elytra bicolored.... militaris.
Elytra with four entire striæ.
Outer thoracic stria abbreviated, usually very short.
A short humeral appendix ; form oblong............ curtatus.
No subhumeral whatever ; form broadly oval........ defectus.
Outer thoracic stria entire.
Pygidium smooth, very minutely punctulate......... indistinctus.
Pygidium very coarsely punctured.................. servus.

H. semisculptus, Lec. New Species, 1863, p. 60.

Inner stria of thorax alone entire, external entirely absent. Elytra with three entire striæ, fourth and fifth very short, sutural one-fourth the length of the elytra, subhumeral entirely absent at apex, a faintly impressed subhumeral appendix alone existing. Pygidium and propygidium coarsely and equally punctured. Epipleuræ unistriate. Anterior tibiæ with outer margin arcuate, 4-dentate, apical tooth bifid. Length .20 inch ; 5 mm.

This species by its oblong form recalls *remotus*. Differs from all the species of the present group by the unistriate epipleuræ.

One specimen, Illinois.

H. dispar, Lec. Bost. Journ. V., p. 57, pl. 3, fig. 8; *hospitus*, Lec. Proc. Acad., 1859, p. 312.

Thorax at sides unistriate, stria distant from the margin. Elytra with three entire striæ, sometimes with trace of fourth at base and apex, sutural extending three-fourths the length of the elytra, subhumeral entirely absent. Epipleuræ bistriate. Propygidium coarsely but very sparsely punctured, pygidium more finely punctured and nearly smooth at apex. Anterior tibiæ tridentate, apical tooth feebly bifid. Length .12-.16 inch; 3-4 mm.

Occurs in the Middle States, Georgia, Illinois and Kansas.

H. depurator, Say. Journ. Acad., 1825, p. 33; Lec. Bost. Journ. V., p. 54, pl. 3, fig. 3; Mars. Mon., 1854, p. 274, pl. 8, fig. 74; *Paykulli*, Kby. Faun. Am. Bor. p. 123; *spretus*, Lec. Bost. Journ. V., p. 53, pl. 3, fig. 1; Mars. Mon., 1854, p. 271, pl. 8, fig. 72.

Thorax bistriate, inner stria always entire, outer variable, sometimes nearly entire, more frequently extending to middle only. Elytra with three entire dorsal striæ, fourth apical rarely extending to middle, fifth existing in mere trace, sutural extending to middle, subhumeral at apex moderately deeply impressed, humeral appendix usually present always very feeble. Epipleuræ bistriate. Propygidium coarsely but very sparsely punctured, pygidium more finely punctured and nearly smooth at apex. Anterior tibiæ tridentate, upper tooth feeble, apical prominent and slightly bifid at tip. Length .22 inch; 5-.5 mm.

Distributed from Canada to Georgia.

H. furtivus, Lec. Proc. Acad., 1859, p. 313.

This species closely resembles the preceding, and differs by the total obliteration of the subhumeral stria. The apex of the prosternal lobe is truncate or emarginate with the sides of the emargination slightly prominent. This latter character will serve to distinguish it from every other species in our fauna. Length .20-.22 inch; 5-5.5 mm.

Occurs from Canada to Georgia.

H. incertus, Mars. Mon., 1854, p. 269, pl. 8, fig. 70.

Closely allied to *depurator*, but differs in the absence of any subhumeral stria, and the epipleuræ distinctly tristriate. Length .16-.24 inch; 4-6 mm.

Occurs from the Middle States to Florida and Texas, and westward to Kansas.

H. militaris, Horn, Trans. Am. Ent. Soc., 1870, p. 135, pl. 1. fig. 4.

Inner thoracic stria entire, outer very short, apical and between the two a few punctures. Elytra with three entire striæ, fourth extending to middle, fifth very short, apical, sutural half the length of the elytra, subhumeral entirely absent. Epipleuræ bistriate. Pygidium and propygidium moderately densely and coarsely punctured. Anterior tibiæ tridentate, apical tooth feebly emarginate. Length .18 inch ; 4.5 mm.

Occurs at Fort Yuma, California.

Differs from all the species of the group by the color of the elytra, which are in great part red with the apical margin and trapezoidal scutellar spot black. The form is also sub-hexagonal.

H. curtatus, Lec. Bost. Journ. V., p. 54, pl. 3, fig. 2 ; Mars. Mon., 1854, p. 272, pl. 8, fig. 73.

Form oblong oval. Inner thoracic stria entire, outer very short, forming merely a short arc at the anterior angle. Elytra with four entire dorsal striæ, fifth short apical, sometimes extending to the middle, sutural longer than the fifth, subhumeral appendix short. Epipleuræ bistriate. Propygidium shining, very sparsely punctate, pygidium nearly smooth with very few punctures at the sides only. Anterior tibiæ feebly tridentate, apical tooth slightly bifid. Length .18 inch ; 4.5 mm.

Differs from the species with 4-striate elytra by its more oblong form, and by the presence of the very short humeral appendix. There is no apical subhumeral stria.

Pennsylvania and Illinois.

H. Haldemanni, Mars. Mon., 1860, p. 547, pl. 7, fig. 37.

From the description and comparisons made by Marseul, I cannot separate this species from *curtatus*. A verification of this must be made before placing this in synonymy.

H. defectus, Lec. Proc. Acad., 1859, p. 312 ; *permixtus*, Zimm. Trans. Am. Ent. Soc., 1869, p. 252.

Broadly oval. Inner thoracic stria entire, outer short apical. Elytra with four entire striæ, fifth short, apical, sutural half the length of the elytra, subhumeral entirely absent. Epipleuræ bistriate. Propygidium sparsely punctured, pygidium nearly smooth, and with a few punctures near the base and sides. Anterior tibiæ tridentate apical tooth deeply bifid. Length .12 inch ; 3 mm.

Very closely allied to the following species, and differs from *servus* by the short external thoracic stria.

Georgia and South Carolina.

H. indistinctus, Say. Journ. Acad., 1825, p. 35 ; Lec. Bost. Journ. V., p. 56, pl. 3, fig. 6 ; Mars. Mon., 1854, p. 574, pl. 10, fig. 137.

Thoracic striæ entire. Pygidium more distinctly punctured. Length .12-.14 inch ; 3-3.5 mm.

The above points are all those from which it differs from *defectus*.

North Carolina and Georgia.

H. servus, Er. Jahrb., 1834, p. 147 ; Mars. Mon., 1854, p. 561, pl. 9, fig. 126 ; Zimm. Trans. Am. Ent. Soc., 1869, p. 252.

Thorax with two entire striæ. Pygidium convex, coarsely and moderately densely punctured, propygidium more coarsely and more densely punctured. Length .12–.14 inch : 3–3.5 mm.

The species, otherwise than in the above noted characters agrees precisely with *defectus*.

Occurs in Maryland, South Carolina, Arizona, and in the West India Islands.

These last three species have the emargination of the mesosternum reduced to a minimum, so that they approach the next group in which the mesosternum is truncate.

Group *Bimaculatus*.

Mesosternum truncate in front. Epipleuræ narrow, unistriate, side pieces of meso- and metasternum grooved.

H. bimaculatus, Linn. Syst. Nat. 1, Vol. 11, p. 567; Lec. Bost. Journ. V., p. 59, pl. 4, fig. 1; Mars. Mon., 1854, p. 582, pl. 12, fig. 142; *obliquus*, Say. Journ. Acad.. 1825, p. 37.

Thorax with a broad shallow impression at the anterior angles within the stria. Side of thorax unistriate, stria fine and not entire. Elytra with five entire striæ, sutural stria extending in front of middle, subhumeral absent. Epipleuræ narrow unistriate, side pieces of meso- and metasternum with a broad moderately deep groove. Anterior tibiæ tridentate. Length .16 inch ; 4 mm.

The elytra are black with that portion external to a line drawn from the humerus to the tip of suture, red. The truncate mesosternum, narrow and unistriate epipleuræ, with the lateral groove of the thoracic side pieces, at once distinguish this from every other Hister in our fauna.

Occurs all over Europe and in the Middle States.

Group *Americanus*.

Mesosternum truncate, epipleuræ moderate, bistriate, side pieces of meso- and metasternum not grooved.

Elytra with two subhumeral striæ.
  Outer subhumeral entire ; thorax unistriate.........sedecimstriatus.
  Outer subhumeral short ; thorax bistriate........... ambigena.
Elytra without subhumeral stria.
  Elytra with five entire dorsal striæ.
    Thorax with two lateral striæ, outer short.
      Surface smooth.............................. americanus.
      Surface distinctly punctured.................. perplexus.
    Thorax with the inner stria only................ exaratus.
  Elytra with four entire dorsals or less.
    Thorax with two lateral striæ, outer short.
      Four entire dorsal striæ. Epipleuræ bistriate.... nubilus.
      Three entire striæ, fourth short basal. Epipleuræ tristriate........................... pollutus.
    Thorax with inner stria only.
      Four entire dorsal striæ. Epipleuræ bistriate... relictus.

H. sedecimstriatus, Say. Journ. Acad., 1825, p. 36; Lec. Bost. Journ. V., p. 57, pl. 3, fig. 9; Mars. Mon., 1854, p. 285, pl. 8, fig. 84.

Thorax with the internal lateral stria entire. Elytra with five entire striæ, deeply impressed, the fifth arching at base, and joining the sutural, two subhumeral striæ, outer entire, inner more deeply impressed terminating at humerus, but continued by the fine oblique humeral. Epipleuræ bistriate. Propygidium coarsely and sparsely punctured, pygidium nearly smooth, very minutely punctulate. Anterior tibiæ finely tridentate, apical tooth finely bifid. Length .16 inch; 4 mm.

Middle States and Canada. Abundant.

H. ambigena, Lec. Proc. Acad., 1859, p. 313.

Inner thoracic stria entire, outer abbreviated, extending nearly to the middle of thorax. Elytra with five entire striæ, fifth arching and joining the sutural, two subhumeral striæ. finely impressed, equal in length, and extending slightly in front of middle. Anterior tibiæ finely 4-dentate, apical tooth bifid. Propygidium and pygidium very sparsely and not coarsely punctured, the latter smoother at apex. Length .14 inch; 3.5 mm.

One specimen, Vermont.

H. americanus, Payk. Mon. p. 31, pl. 9, fig. 1; Lec. Bost. Journ. V., p. 56, pl. 3, fig. 7; Mars. Mon., 1854, p. 575, pl. 10, fig. 138.

Thorax with inner stria entire, outer abbreviated, rarely more than an arc at the anterior angle. Elytra with three entire striæ, fourth very slightly abbreviated, fifth curved at base and very rarely joining the sutural, striæ finely impressed. Upper surface smooth. Epipleuræ bistriate. Propygidium coarsely but sparsely punctured, pygidium more finely punctured and nearly smooth at apex. Anterior tibiæ tridentate, apical tooth prominent, and finely bifid at tip. Length .12-.16 inch; 3-4 mm.

Occurs abundantly from Canada to Georgia and Kansas.

H. perplexus, Lec. New Species, 1863, p. 61.

Closely allied to the preceding species, and differing in the following slight characters: Surface sparsely and finely punctured. Elytra with three entire striæ, fourth very slightly shorter, fifth equal to the fourth, and joining the sutural. Striæ rather strongly impressed and punctured. Length .16 inch; 4 mm.

As the specimens of this species are better developed than the preceding, it seems probable that they are mere local varieties.

Occurs in Canada, Middle States, Illinois and Wisconsin.

H. exaratus, Lec. Bost. Journ. V., p. 59, pl. 3, fig. 12.

Closely allied to *perplexus*, but differs as follows: Thorax with the inner stria only. Elytra with striæ finer. Surface not punctured. Length .14 inch; 3-5 mm.

One specimen, Georgia.

H. nubilus, Lec. Col. Kansas, 1859, p. 7.

Inner thoracic stria entire, outer very short apical. Elytra with four entire striæ, fifth short apical, sutural extending in front of middle. Epipleuræ bistriate. Propygidium sparsely punctured, pygidium more finely punctured and nearly smooth at apex. Anterior tibiæ finely 4-dentate, apical tooth slightly bifid. Length .18 inch ; 4.5 mm.

The fourth stria is so very slightly abbreviated at base that it may be called entire, as is also the same in the three preceding species.

Kansas.

H. pollutus, Lec. Col. Kansas, 1859, p. 7.

Closely resembles the preceding, and differs as follows : Outer thoracic stria extending beyond the middle of thorax. Fourth dorsal stria of elytra short basal. Epipleuræ finely tristriate. Length .18 inch ; 4.5 mm.

Kansas.

H. relictus, Mars. Annales, Belg. XIII, p. 89.

Lateral stria deeply impressed, slightly abbreviated at base, a slight impression within the angle at apex. Elytra with four entire punctured striæ, fifth and sutural abbreviated at basal end. Subhumeral wanting. Epipleuræ bistriate. Pygidium convex sparsely punctured, propygidium similarly, but more coarsely punctured. Anterior tibiæ with four fine teeth, the apical large and prominent. Length 4 mm. (.16 inch).

This species is known by the description only and from it the above extract has been made. Marseul compares this species with *corvinus*, which it resembles very closely, and is probably that cited by Zimmerman (Trans. Am. Ent. Soc., 1869, p. 252) as *corvinus*. The specimen on which the determination was made, does not appear in the cabinet of the latter author.

United States (Marseul), South Carolina (Zimm.).

Sub-genus *Phelister*.

Inner thoracic stria entirely absent, outer stria sometimes present, and then very close to margin. Tarsal grooves not limited on the outer side. Mesosternum prominent in front, prosternum at tip correspondingly emarginate. Hind tibiæ finely biseriately spinulose. Prosternum striate.

Prosternum between the striæ flat, striæ distant ; surface metallic.
  Thorax without sub marginal stria.
    Form oblong..**æneomicans.**
    Form broad .... **venustus.**
Prosternum between the striæ convex, striæ approximate ; surface piceous or black.
  Thorax with distinct sub marginal stria ; five entire dorsals, **subrotundus.**
  Thorax with no sub-marginal stria ; four entire dorsal elytral striæ.
    Pygidium smooth, very sparsely and finely punctulate **vernus.**
    Pygidium densely punctulate........................ **Saunieri.**

H. æneomicans, n. sp.

Oblong oval, subdepressed, surface brilliantly æneous, antennæ and legs rufous. Head sparsely punctured, front not concave supra-orbital striæ distinct. Thorax sparsely punctured on the disc, more coarsely at the sides, marginal stria entire. Elytra sparsely punctured at apex, humeral stria short, basal; dorsals 1–4 entire, fifth abbreviated at base, continued at apex by punctures, striæ punctured except the basal portion of the fourth; sutural stria short basal half wanting, apical portion continued by punctures. Propygidium coarsely punctured, pygidium more finely and less densely punctured. Anterior tibiæ sub-quadridentate, the upper tooth obsolete. Length .07 inch; 1.75 mm. Plate V., fig. 1.

This species is closely allied to *venustus*, from which it differs by its more oblong form, smaller size, front not concave, more deeply impressed elytral striæ and much more coarsely punctured thorax. The two species differ remarkably on comparison, and much more than the description would seem to indicate.

One specimen in the cabinet of Mr. Ulke, collected in the District of Columbia.

H. venustus, Lec. Ann. Lyc. V., p. 163; Mars. Mon., 1853, p. 468, pl. 14. fig. 1.

Oval, moderately convex, brilliant greenish-blue. Antennæ and legs reddish-brown. Front concave, coarsely and sparsely punctured. Thorax very finely and sparsely punctulate at middle, more coarsely toward the sides. Elytra at tip with a few coarse punctures, surface with four entire striæ, a very short humeral, fifth and sutural extending to middle. Propygidium coarsely and sparsely punctured, pygidium more densely and finely. Anterior tibiæ quadridentate, the second and third teeth more distant. Length .10 inch; 2.5 mm.

Marseul states that the hind tibiæ of this species have a single terminal spur, but two closely approximate spurs of equal length are distinctly visible with sufficient power.

One specimen has the fifth dorsal entire, but very fine at base.

Georgia, Louisiana and Texas, very rare.

H. subrotundus, Say. Journ. Acad., 1825, p. 39; Lec. Bost. Journ. V., p. 60, pl. 4, fig. 2; Mars. Mon., 1853, p. 487, pl. 14, fig. 19.

Broadly oval, black, shining, antennæ and legs reddish-brown. Front concave, sparsely punctured. Thorax finely punctulate on the disc, more coarsely at the sides. Marginal stria distinct, close to margin. Elytra with five entire striæ, sutural extending in front of middle. Propygidium sparsely punctured, pygidium nearly smooth, sparsely and minutely punctulate. Anterior tibiæ multidenticulate. Length .08–.10 inch; 2–2.5 mm.

Occurs over the entire country from Canada to Kansas, and southward to Georgia and Texas.

H. vernus, Say. loc. cit., p. 40; Lec. loc. cit. pl. 4, fig. 3; Mars. Mon., 1853, p. 478, pl. 14. fig. 11.

Closely allied to the preceding species, it differs by the absence of any marginal thoracic stria and by having four entire dorsal striæ only, to the elytra, the fifth and sutural extending from apex to middle. Length .08–.10 inch ; 2–2.5 mm.

Occurs with the preceding species.

H. Saunieri, Mars. Mon., 1861, p. 162, pl. 4, No. 15, fig. 6.

Differs from *vernus* by its stronger punctuation, and especially by the pygidium being densely punctured.

Found by Marseul near Rochester, New York. Unknown to us.

Sub-genus *Platysoma.*

Anterior tibiæ with tarsal groove deep, sinuate. Thorax without inner lateral stria. Prosternum without marginal line at apex. Middle and hind tibiæ dentate. Anterior tibiæ with inner margin straight, and without dentiform process near the base.

Body broad, not twice as long as wide, depressed ; elytra with not more than three entire dorsal striæ.

Anterior tibiæ 5-dentate sutural stria well marked........ **carolinus.**

Anterior tibiæ 4-dentate ; sutural obsolete or wanting.

Sides of thorax smooth................................. **aurelianus.**

Sides of thorax punctured.............................. **Lecontei.**

Body elongate, more or less cylindrical, always as long or longer than twice the width. Elytra with more than three entire dorsal striæ.

Sutural stria entire.

All the dorsal elytral striæ entire ; sub-cylindrical ; mesosternal stria entire.................................... **parallelus.**

Fifth dorsal abbreviated at base ; depressed ; mesosternal interrupted.................................. **æquus.**

Sutural stria short, or at least, abbreviated.

Mesosternal stria entire.

Thorax evenly punctured ; fifth and sutural striæ long... **coarctatus.**

Thorax smooth at middle ; fifth and sutural abbreviated.. **punctiger.**

Mesosternal stria broadly interrupted................. **basalis.**

H. carolinus, Payk. Mon., p. 45, pl. 10, fig. 2 ; Lec. Bost. Journ. V., p. 39, pl. 1, fig. 3 ; Mars. Mon., 1853, p. 269, pl. 7, fig. 14 ; *sordidum*, Say. Journ. Acad., 1825, p. 44.

Broadly ovate, sub-depressed. Thorax with outer marginal stria entire ; surface smooth, impunctate. Elytra with three entire dorsal striæ, fourth and fifth apical, extending to middle, sutural somewhat longer. Propygidium coarsely and not very densely punctate, pygidium much more finely and sparsely punctured, nearly smooth at apex. Anterior tibiæ finely 5-dentate, second and third denticles more distant, middle tibiæ 4, hind tibiæ 3-spinous. Body black, shining, legs reddish-brown. Length .12 inch ; 3 mm.

Occurs from the Middle States to New Mexico.

H. Lecontei, Mars. Mon., 1853, p. 273, pl. 7, fig. 17 ; *depressus*, ‡ Lec. Bost. Journ. V., p. 40, pl. 1, fig. 4.

Slightly longer and more depressed than *carolinus*. Thorax smooth at middle, sparsely punctured at the sides, marginal stria entire. Elytra with three entire dorsal striæ, fourth apical, extending to middle sometimes very nearly entire, fifth short apical, sutural feeble equal to the fifth. Propygidium coarsely, but very sparsely punctured, pygidium coarsely punctured at base, more finely and sparsely at apex. Anterior tibiæ 4-dentate, middle 3-, apical 2-spinous. Length .10–.12 inch ; 2.5–3 mm.

Occurs abundantly over nearly our entire territory. The specimens from California all differ from those of the Atlantic region by the entire obliteration of the frontal stria. As there are no other discoverable points of difference, I prefer to regard them merely as varieties.

H. aurelianus. n. sp.

Closely allied to *Lecontii*, but more depressed and differing as follows :

Thorax not punctured at the sides. Elytra with three entire dorsals, fourth very short, apical, fifth obsolete, sutural entirely absent. Length .12 inch ; 3 mm.

Kindly presented to Dr. Leconte, by M. Sallé, who received it from the neighborhood of New Orleans, Louisiana.

The above three species have the mesosternal stria entire.

H. parallelus, Say. Journ. Acad., 1825, p. 42 ; Lec. Bost. Journ. V., p. 40, pl. 1, fig. 5 ; Mars. Mon., 1852, p. 264, pl. 7, fig. 9.

Moderately elongate, sub-cylindrical. Thorax sparsely and evenly punctured. Elytra with the five dorsal and sutural striæ entire, and with a short basal humeral stria. Pygidium and propygidium very coarsely, but sparsely punctured. Mesosternal marginal stria entire. Anterior tibiæ 4-dentate, apical tooth bifid, middle tibiæ 4-, posterior 2-spinous. Length .10 inch ; 2.5 mm.

Occurs in Georgia, South Carolina and Florida.

H. æquus, Lec. New Species, 1863, p. 61 ; *frontalis*, ‖ Say. Journ. Acad., 1825, p. 43.

Closely allied to the preceding, but more depressed. Fifth dorsal stria always abbreviated at base. Mesosternal stria broadly interrupted at middle. Middle tibiæ 3-spinous. Length .08 inch ; 2 mm.

Occurs in Georgia.

H. coarctatus, Lec. Bost. Journ. V., p. 41, pl. 1, fig. 6 ; Mars. Mon., 1853, p. 282, pl. 7, fig. 25.

Elongate parallel, cylindrical. Thorax evenly but not densely punctured. Elytra with four entire dorsal striæ, fifth three-fourths and sutural two-thirds the length of the elytra, a very short basal humeral. Propygidium coarsely, but sparsely punctured, pygidium finely, and very nearly smooth at apex. Mesosternal stria entire. Length .10–.12 inch ; 2.5–3 mm.

Closely resembles *parallelus*, but is narrower and slightly more convex. Occurs with the *parallelus*. I have also seen a specimen from Canada.

H. punctiger, Lec. Proc. Acad., 1861, p. 343.

Thorax minutely punctulate on the disc, more coarsely punctured at apex and at the sides. Elytra with four entire dorsals, a trace of humeral, fifth extending to middle, sutural longer. Propygidium and pygidium coarsely and sparsely punctured. Mesosternal stria entire. Anterior tibiæ quadridentate, middle 4-, posterior 2-spinous. Length .14 inch ; 3.5 mm.

More robust than the preceding species, and differing more by its general aspect than by any well defined characters.

Occurs in California, Oregon and Nevada.

H. basalis, Lec. Proc. Acad., 1861, p. 343, note.

Closely allied in sculpture to *punctiger*, but more robust. Pygidium and propygidium more sparsely punctured, the former nearly smooth at apex. Mesosternal stria broadly interrupted at middle. Middle and hind tibiæ 3-spinous. Length .16 inch ; 4 mm.

Occurs in Ohio.

Sub-genus *Cylistix*.

Thorax with inner stria absent, outer stria entire and close to the margin. Anterior tibiæ with small dentiform process on the inner edge near the base. Prosternum convex, with a marginal stria continuing around the apex. Mandibles moderately prominent. Form cylindrical, elongate.

Marginal stria of prosternal lobe entire. Sutural stria entire.
  Hind tibiæ with two teeth at middle.................. cylindricus.
  Hind tibiæ with one tooth at middle.................. attenuatus.
Marginal stria of prosternal lobe broadly interrupted.
  Fifth dorsal and sutural striæ abbreviated at base.... gracilis.

H. cylindricus, Payk. Mon., p. 91, pl. 10, fig. 5 ; Lec. Bost. Journ. V., p. 42, pl. 1, fig. 8 ; Mars. Mon., 1853, p. 289, pl. 7, fig. 1 ; Lac. Atlas, pl. 17, fig. 2 ; ? *cylindricus*, Beauv. Ins., p. 178, pl. 6, b, fig. 1.

Elongate, cylindrical, black, shining. Legs reddish-brown. Head sparsely punctured, clypeus concave, the concavity extending in triangular form on the front. Thorax quadrate, sparsely punctured with moderate and fine punctures intermixed. Elytra with four entire striæ, fifth extending from apex to basal fourth, sutural entire. Propygidium and pygidium with very coarse and sparsely placed punctures. Anterior tibiæ 4-, middle 4-, posterior 3-dentate. Length .18 inch ; 4.5 mm.

Occurs from Massachusetts to Texas, not common.

H. attenuatus, Lec. Bost. Journ. V., p. 42, pl. 1, fig. 9 ; ? *elongatus*, Beauv. Ins., p. 178, pl. 6, b, fig. 2.

Closely allied to the preceding, but smaller and more slender. Fifth dorsal stria short, composed almost entirely of punctures. Anterior tibiæ 4-, middle 4-, posterior 2-dentate. Length .10–.12 inch; 2.5–3 mm.

Occurs in North Carolina and Georgia.

H. gracilis, Lec. Bost. Journ. V., p. 41, pl. 1. fig. 7; Mars. Mon., 1857, p. 405, pl. 11, No. 9, fig. 24.

Similar in aspect to *attenuatus*, but with the front less concave, sutural stria extending three-fourths, fifth stria extending to middle. Propygidium very sparsely punctured, pygidium nearly smooth. Marginal stria of prosternal lobe entirely obliterated. Anterior tibiæ 4-, middle 3-, posterior 2-dentate. ' Length .10–.12 inch; 2.5–3 mm.

Occurs in the Middle States.

TRIBALISTER, n. g.

Prosternum moderately lobed in front, lobe slightly depressed. Mesosternum truncate in front. Antennæ inserted under a slight frontal process, front joint moderate, joints of funicle gradually thicker, club gradually formed, solid, pubescent, oval and not truncate at tip. Antennal cavity in the anterior angle of the thorax between the dorsal and pectoral laminæ.

The solid club of this insect allies it not only with *Hetærius*, but also with *Scapicœlis*. In both these genera, however, the club is truncate, and in the former glabrous. The legs are those of *Phelister*, while the form of the body resembles *Tribalus*, inasmuch as the margins of the thorax and elytra are continuous and slightly reflexed. From *Scapicœlis* it differs not only in the form of the legs, but also in the construction of the first joint of the antennæ, which in the present genus is that which is usual in the Histeridæ, while in *Scapicœlis* the form is nearly that of *Echinodes*.

T. marginellus, Lec. Proc. Acad., 1859, p. 311.

Pale reddish-brown, smooth shining. Head shining, supra-ocular stria well marked, frontal stria obliterated, front slightly concave. Thorax twice as wide at base as long, sides feebly arcuate, anterior angles broadly rounded, disc moderately convex, smooth shining, margin slightly reflexed. Elytra as broad as long, moderately convex, smooth shining, apex slightly punctured, margin acute continuous with the thoracic and slightly reflexed, disc with four nearly entire striæ, the outer side of each elevated in the form of an acute carina, which is very strong at apex and gradually feebler to base, striæ gradually converging to apex, sutural stria simple extending from apex half to base, epipleuræ bistriate. Pygidium sparsely punctured, shining, propygidium more densely punctured. Prosternum flat, bistriate, stria obliterated at apex. Mesosternum with marginal line entire. Anterior tibiæ 5-denticulate, middle and hind tibiæ finely spinulose. Length .08 inch. 2 mm. Plate V., fig. 2.

The curious sculpture of the elytra of this insect has no parallel among our Histeridæ, and will serve to make it known should the unique specimen before me be duplicated.

The affinities of this insect may be summed up as a Phelister with a gradually formed antennal club, the latter solid, oval, not glabrous, nor truncate, and with the elytral and thoracic margins continuous.

One specimen, Maryland.

EPIERUS, Er.

Antennæ inserted under the frontal margin, cavity at the anterior portion of prothorax, within the angle and partly concealed beneath by the pectoral plate, open in front and laterally.

Our species resemble each other closely, and are known by the following table :

- Elytra with all the striæ entire.
  - Epipleuræ deeply bistriate.... . ... **regularis.**
  - Epipleuræ unistriate.
    - Pygidium finely rugulose, coarsely punctured............ **novellus.**
    - Pygidium smooth, finely punctured.
      - Body moderately convex ; subhumeral sinuous.........**pulicarius.**
      - Body subdepressed ; subhumeral straight.............. **ellipticus.**
- Elytra with the fifth dorsal and sutural abbreviated at base.
  - Clypeus not tuberculate.................................. **planulus.**
  - Clypeus with acute tubercle at middle of anterior margin.... **nasutus.**

E. coproides, Mars. is omitted in the above table as it is without doubt South American.

E. regularis, Beauv. Ins., p. 180, pl. 6, b, fig. 8 ; *nigrellus*, Say. Journ. Acad., 1825, p. 38 ; Lec. Bost. Journ. V., p. 62, pl. 4, fig. 5, Mars. Mon., 1854, p. 692, pl. 10, fig. 13 ; var *vicinus*, Lec. Ann. Lyc. V., p. 164 ; Mars. l. c., p. 693, pl. 10, fig. 14.

Oblong oval, black, shining, legs piceous. Head shining, minutely punctulate. Thorax not densely punctulate, punctures coarser and finer intermixed, both grades becoming rather coarser toward the base. Each elytron with six entire punctured striæ, intervals sparsely and minutely punctulate, subhumeral entire, rather deeply impressed, epipleural fold deeply bistriate and coarsely punctured. Propygidium with moderate punctures sparsely placed, pygidium minutely punctured. Length .08–.12 inch ; 2–3 mm.

I am unable to find any differences whatever between the *regularis* and *vicinus*, the characters given by Marseul, vanishing entirely even in a small series.

Occurs in Georgia, Texas, Arizona and Southeastern California, under bark of trees, in the latter locality under cottonwood bark.

E. novellus, Zimm. Trans, Am. Ent. Soc., 1869, p. 253.

More elongate and parallel than the preceding species. Thorax more coarsely punctured. Elytral striæ entire, intervals sparsely punctulate, subhumeral stria moderately impressed, inferior to the margin and slightly arcuate at basal end, epipleuræ unistriate, sparsely punctured. Propygidium and pygidium finely rugulose and coarsely, but sparsely punctured. Length .08 inch ; 2 mm.

One specimen, North Carolina.

E. pulicarius, Er. Jahr., 1834, p. 162 ; Mars. Mon., 1854, p. 705, pl. 10, fig. 25 ; *minor*, Lec. Bost. Journ. V., p. 73, pl. 4, fig. 6.

Oval, moderately convex, piceous black, shining. Thorax sparsely punctured. Elytræ with six entire striæ, subhumeral slightly inferior, epipleuræ finely unistriate, sparsely punctured. Pygidium minutely punctured, punctures at base coarser, propygidium sparsely and more coarsely punctured Length .06–.08 inch ; 1.5–2 mm.

Occurs in Florida, Georgia and Texas.

E. ellipticus, Lec. Proc. Acad., 1859, p. 313.

This species differs from *pulicarius*, by its broader and more depressed form. The subhumeral stria is marginal and straight, and not sinuous and inferior as in the preceding species. Length .10–.12 inch ; 2.5-3 mm.

Occurs in the Southern States.

E. planulus, Er. Jahr., 1854, p. 162 ; Mars. Mon., 1854, p. 702, pl. 10, fig. 22 ; *decipiens*, Lec. Ann. Lyc. V., p. 164.

Oblong oval, moderately depressed. Elytra with four entire dorsal striæ, fifth extending three-fourths to base, sutural extending slightly in front of middle, subhumeral inferior, slightly sinuous, epipleuræ unistriate sparsely punctured. Pygidium and propygidium sparsely punctured. Length .10 inch ; 2.5 mm.

Occurs near Fort Yuma, California.

E. nasutus, n. sp.

Almost precisely identical with *planulus*, and differing only in having a dentiform process from the clypeus at its middle slightly behind the anterior margin. Length .08–.10 inch ; 2–2.5 mm.

Occurs at Fort Yuma, and in Arizona, under Cottonwood bark.

Four specimens precisely identical, otherwise this character might be considered an accidental deformity.

TRIBALUS, Erichs.

Antennæ inserted under the margin of the front, club rounded, feebly truncate at tip. Antennal cavity at the anterior angle of the thorax between the dorsal and pectoral plates, open in front and laterally.

Two species occur in our fauna.

Pygidium oblique, elytra obsoletely striate............... americanus.
Pygidium inflexed, elytra with outer striæ ~~of the elytra~~
replaced by fine raised lines............................californicus.

T. americanus, Lec. Bost. Journ. V., p. 64, pl. 4. fig. 7 ; Mars. Mon., 1855, p. 159, pl. 9, No. 31, fig. 5.

Broadly oval, convex, black, feebly shining, rather densely punctured. Elytra with four dorsal striæ, the first and second apical, third and fourth basal. Pygidium and progygidium densely punctured, the former vertical. Thoracic and elytral margins continuous, and on both members slightly reflexed. Length .08–.10 inch; 2–2.5 mm.

This insect though not very common is contained in nearly all the collections, and may be readily known from all our Histeridæ by the generic characters, and the above short extract.

Occurs from Maryland to Texas and Illinois.

T. californicus, Horn, Trans. Am. Ent. Soc., 1870, p. 1, pl. 1, fig. 11.

Broadly oval moderately convex, feebly shining. Head and thorax coarsely but sparsely punctate. Elytral margin continuous with the thoracic and acute. Elytra with three entire fine raised lines, and a fourth abbreviated, extending from base to the middle of the elytra. Intervals obsoletely punctured. Body beneath sparsely punctate. Legs pale reddish-brown. Length .06 inch; 1.5 mm.

Occurs near Sacramento, California.

Notwithstanding the dissimilarity of this species and the preceding, I cannot find it generically different, even with the difference in the position of the pygidium.

T. lævigatus, Payk. (*lævissimus* Lec.), is West Indian and South American. Its reference to the United States is doubtless erroneous.

ONTHOPHILUS, Leach.

Antennæ inserted on the front immediately in front of the eyes. Club oval, annulate. Antennal fossa under the margin of the thorax behind the anterior angle, deep and closed in front, open beneath. Tibiæ slender, the anterior finely denticulate.

Two species only are known in our fauna.

Thoracic carinæ feeble, elytral carinæ equal, pygidium shining, surface even without carinæ.......................... **Lecontei.**
Thoracic carinæ strong, elytral carinæ uneqal, pygidium and propygidium opaque, and with elevated lines...............**alternatus.**

O. Lecontei, Horn, Trans. Am. Ent. Soc., 1870, p. 138, pl. 1, fig. 10.

Broadly oval, black, moderately shining. Head densely punctured, V-shaped carina feeble, front slightly concave. Thorax twice as wide at base as long, at apex broader than the length, sides gradually arcuate from base to apex, margin slightly reflexed; disc densely punctured, shining with six feeble carinæ, the middle two beginning at the apical margin, but not attaining the base, the second slightly abbreviated at apex and base, outer carinæ arcuate and abbreviated at apex and base; the four middle carinæ nearly equidistant. Elytra with six dorsal and a marginal entire carinæ, carinæ moderately elevated, intervals finely tri-carinulate, the middle carina of each interval interrupted by a row of coarse punctures. Epipleuræ coarsely punctured shining, limited above by a sinuous elevated line. Propygidium transversely hexagonal, moderately shining, coarsely punctured, pygidium elongate oval, inflexed, more finely punctured than the propygidium and more shining. Length .16 inch ; 4 mm.

One specimen, Fort Tejon, California.

O. alternatus, Say. Journ. Acad., 1824, p. 46 ; Lec. Bost. Journ. V., p. 82, pl. 6, fig. 9 ; var. *pluricostatus*, Lec. l. c., p. 81 ; var. *nodatus*, Lec. l. c., p. 83 ; Mars. Mon., 1856, p. 558, pl. 11, No. 40, fig. 4 (*alternatus*) ; l. c. p. 556, fig. 3 (*nodatus*).

Broadly oval, very convex above, surface either moderately shining or opaque. Head with strong V-shaped carina, vertex slightly concave with short acute carina. Thorax twice as wide as long, disc coarsely punctured margins slightly reflexed, sides strongly arcuate, disc with six carinæ, the middle four entire, equidistant and slightly convergent to apex, outer carinæ short basal. Elytra carinate, carinæ variable in size. Epipleuræ coarsely foveatato-punctate. Propygidium coarsely punctate, with three longitudinal carinæ, the median entire, the lateral short. Pygidium coarsely punctured with two semicircular elevated lines at base and a longitudinal short carina at apex. Body beneath very coarsely punctate.

Var nodatus, Lec. Thorax with the sides more strongly arcuate. Elytra with three entire dorsal and a marginal, costæ ; intervals finely 5-carinulate, the third carinula slightly stronger, 2 and 4 interrupted by distant punctures. Length .10–.12 inch ; 2.5–3 mm.

Var. alternatus, Say. Surface more shining, thorax with sides less arcuate, third carinula stronger. Length .08 inch ; 2 mm.

Var. pluricostatus, Lec. Resembles *alternatus*, but less shining. Third carinula equal to the main carina. Length .08–.10 inch ; 2–2.5 mm.

I find it impossible with the series of specimens before me to separate, other than as varieties, the species above noted.

Occurs from Massachusetts to Georgia, but rare.

HETÆRIUS, Erichs.

Anterior angles of thorax dilated.
  Legs, especially the posterior long...................... morsus.
Anterior angles not dilated, thorax arcuately narrowed from base to apex.
    Lateral thickened margin of thorax with a transverse sulcus..brunnipennis.
    Lateral thickened margin notched slightly behind the middle.. californicus.

H. morsus, Lec. Proc. Acad., 1859, p. 70 ; Horn, Trans. Am. Ent. Soc., 1870, pl. 1, fig. 6.

Ferruginous brown, feebly shining, very sparsely clothed with very short bristly recumbent hairs, with a very few erect hairs more sparsely placed. Head concave, opaque. Thorax broader than long, on each side a broad oblique groove smooth at bottom, broader and deeper behind, disc of thorax (that is, the part between the grooves) truncate in front, arcuate at base and nearly twice as wide as apex, surface feebly shining, sparsely pubescent with recumbent bristle-like hairs; margin of thorax (part exterior to the grooves), divided behind the middle by a deep fossa into two portions, the posterior globular, the anterior of irregular pentagonal shape, the upper surface of which is flat, subopaque and pubescent. Elytra more shining than the thorax, less pubescent, with striæ indicated by finely elevated lines, of which the subhumeral and first dorsal are entire, the second dorsal three-fourths, and the third nearly two-thirds the length of the elytra. Propygidium transversely hexagonal, sparsely punctured, pygidium oval, longer than wide, minutely and very sparsely punctulate. Prosternum at tip deeply emarginate, marginal line scarcely evident, surface opaque; behind the lobe constricted and with a transverse impression, tip of lobe emarginate. Antennæ with first joint triangular, coarsely punctured, club not annulated, glabrous and truncate at tip. Anterior tibiæ gradually broader at basal third, then parallel to apex which is rounded, outer edge in its entire length minutely denticulate, tarsal groove straight and shallow; middle and hind tibiæ similar in form to the anterior, outer edge finely spinulose. Length .12 inch; 3 mm. Plate V., fig. 3.

In its general aspect, and by the length of the legs this species resembles the genus *Terapus*.

One specimen, Fort Tejon, California.

H. brunnipennis, Rand. Bost. Journ. II., p. 40; Mars. Mon., 1857, p. 433, pl. 11, No. 28, fig. 2; Horn, Trans. Am. Ent. Soc., 1870, pl. 1, fig. 8.

Pale chestnut brown, shining. Front slightly concave, shining. Thorax on each side with a groove parallel with the margin, disc smooth, shining, marginal space less shining and divided by a shallow transverse fossa slightly behind the middle, anterior angles obliquely truncate. Elytra with entire subhumeral stria, dorsal striæ as in *morsus*, but less distinctly defined by the elevated lines, and with erect fine hairs sparsely placed along the line of the striæ. Propygidium and pygidium as in *morsus*, but absolutely smooth and shining. Prosternum between the coxæ smooth and shining with an elevated marginal line. Tip of prosternal lobe emarginate. Legs similarly formed to *morsus*, but less elongate. Length .06 inch; 1.5 mm.

This is our nearest species to the *quadratus* of Europe, from which it abundantly differs by the transverse sulcus in the thickened margin.

Occurs in the Middle States and Illinois.

H. californicus, Horn, Trans. Am. Ent. Soc., 1870, p. 137, pl. 1, fig. 7.

Head shining, pubescent. Thorax nearly twice as wide at base as long, lateral sulci moderate anteriorly, deep and broad at base, margin convex, shining with a constriction slightly behind the middle ; sides of thorax pubescent. Elytra with three entire dorsal striæ and subhumeral entire. Pygidium and propygidium smooth shining. Prosternum between the coxæ narrow with elevated marginal line meeting in front above the middle of prosternum. Prosternal lobe in front feebly emarginate. Length .08 inch ; 2 mm.

Collected at Sonoma, California.

ECHINODES, Zimm.

Prosternal lobe elongate, broad and slightly deflexed. Antennæ with the first joint elongate truncate at tip and concealing the joints of the funiculus when viewed from the front, second joint inserted near the base of the first, club elongate oval, glabrous, truncate at apex.

E. setiger, Lec. Proc. Acad., 1859, p. 316 ; Zimm. Trans. Am. Ent. Soc., 1869, p. 253.

Broadly oval, moderately convex, rufo-piceous, moderately shining. Front obtusely carinate and with a transverse groove at the base of clypeus. Clypeus moderately prominent, narrow at base, dilated toward apex and acutely emarginate, on each side of base of clypeus a short acute process. Thorax nearly three times as wide at base as long, apex moderately emarginate, base arcuate, sides moderately arcuate and gradually narrowing to apex. Surface shining with sparsely placed fine setigerous punctures, at sides with fine stria close to the margin. Elytral margin continuous with the thoracic, acute nearly to apex and with six dorsal and a sutural stria replaced entirely by punctures, the two outer stria with the punctures in a double series, those of the inner rows gradually more confused and broader, each puncture setigerous, intervals smooth shining. Propygidium and pygidium coarsely but sparsely punctured, each puncture bearing a short seta. Prosternum at tip emarginate, bistriate, striæ divergent at tip, and continuing to the base of lobe. Lobe broad, deflexed, smooth. Mesosternum produced at middle. Tibiæ elongate oval, finely spinulose on the outer margin. Entire length .06 inch ; 1.5 mm. Plate V., fig 4.

Resembles *Eretmotus* in the form of the antennæ and somewhat in the form of the legs, but differs abundantly from all the *Hetærius*-like genera by the broader and longer prosternal lobe. The peculiar sculpture of the head recalls that of some species of *Dyschirius* in the mode of its formation.

Rare in South Carolina and Georgia, occurs with a pale species of Ant, the name of which is unknown to me, and which has the metathoracic segment bispinous, and the first two segments of the abdomen slender and gibbous above.

PAROMALUS, Erichs.

The antennal club is received in a cavity at the middle of the prothoracic parapleuræ.

The species are thus distinguished :

- Form strongly depressed, elytra without entire striæ. Prosternum bistriate.
  - Third dorsal stria strongly impressed, more than one-third the length of elytron.............. **æqualis.**
  - Third dorsal stria obliterated or existing in a mere trace.................................. **estriatus.**
- Form moderately convex, elytra striate. Prosternum bistriate.
  - Fourth dorsal stria joining the sutural by an arc; subhumeral very short or obsolete.
    - Elytra normally striate, intervals flat......... **conjunctus.**
    - Elytra with deeply impressed striæ, intervals concave.................................. **geminatus.**
  - Fifth dorsal or none joining the sutural, fourth not arched.
    - Surface metallic. Subhumeral stria entire, fifth dorsal abbreviated.................. **mimeticus.**
    - Surface not metallic, black or piceous.
      - Subhumeral stria entire.
        - Form oval, moderately convex.
          - Fifth dorsal stria entire.
            - Sutural stria entire, joining the fifth...**quatuordecimstriatus.**
            - Sutural stria abbreviated............. **lautus.**
          - Fifth dorsal continued by distant punctures.
            - Sutural stria abbreviated............ **opuntiæ.**
        - Form parallel, subcylindrical............ **tejonicus.**
      - Subhumeral short, apical, sometimes wanting.
        - Form broadly oval, convex.
          - Subhumeral distinct at apex ; a short outer subhumeral.................. **consors.**
          - Subhumeral entirely obliterated........ **gilensis.**
        - Form oblong strongly depressed.
          - Subhumeral abbreviated at base and apex................................ **tenellus.**
- Form convex, elytra without entire striæ, prosternum not striate, anterior tibiæ minutely 4-dentate.
  - Form oblong, subdepressed, marginal stria of mesosternum visible at middle............... **bistriatus.**
  - Form oval, convex, mesosternal stria broadly interrupted .... **seminulum.**

P. æqualis, Say. Journ. Acad., 1825, p. 41; Lec. Bost. Journ. V, p. 63, pl. 4, fig. 9; *affinis*, Lec. loc. cit. fig. 10; Mars. Mon., 1855, p. 108, pl. 8, figs. 1, 2.

Sub-elliptical, piceous shining, strongly depressed, surface sparsely and finely punctulate. Elytra with deep oblique humeral stria, first dorsal visible at middle only and usually deep, second extending from apex to beyond the middle, third stria basal, short. Propygidium finely and sparsely punctulate. Pygidium coarsely sculptured, cicatrix like ♂, smoother and much less rugose ♀. Anterior tibiæ 5-dentate. Length .10–.12 inch; 2.5–3 mm.

I have united the species *affinis*, Lec. to that of Say, as there does not appear to exist between them any point of difference. The form of the two is precisely identical, the difference in this respect indicated by Marseul being rather sexual than specific; the striæ vary greatly in the degree of impression, and by this, two forms might be selected as types of the two species between which very few individuals would form a perfect series. A glance at the figures by Marseul and Leconte will show the propriety of placing the two as synonymous.

Occurs from Canada to Georgia.

P. estriatus, Lec. Proc. Acad., 1859, p. 314.

Slightly more convex than *æqualis* and differs in its sparser and finer punctuation and by all the striæ obliterated with the exception of a faint trace of the second at apex and the third at base. Length .10 inch; 2.5 mm.

I have also considerable doubt as to the propriety of retaining this species as distinct, but the total obliteration of the first dorsal stria with the somewhat more convex form have induced me to retain it until intermediate forms present themselves.

Occurs from Canada to Louisiana.

P. conjunctus, Say, Journ. Acad. 1825, p. 38; Lec. Bost. Journ. V, p. 68, pl. 5, fig. 1; Mars. Mon. 1855, p. 89, pl. 8, No. 22, fig. 2.

Oval, moderately convex, black, shining. Thorax finely punctulate, punctures at the sides more distinct. Elytra with a very short and fine subhumeral stria at apex, dorsals 1-4 entire, punctured, the fourth broadly arching at base and joining the sutural, fifth stria extending in front of middle. Propygidium moderately punctured, pygidium shining, sparsely and minutely punctulate. Anterior tibiæ bidentate. Length .10 inch; 2.5 mm.

Occurs in the Gulf States.

P. geminatus, Lec. Proc. Acad., 1859, p. 314.

Similar in form to the preceding, but less shining. Elytra with the subhumeral stria fine, extending from apex three-fourths to base, dorsals 1-4 entire, the latter arching at base to join the sutural, fifth stria abbreviated at base, striæ deeply impressed, intervals slightly concave. Propygidium rather coarsely but sparsely punctured, pygidium nearly smooth, very sparsely and minutely punctulate. Anterior tibiæ bidentate and above the upper tooth minutely denticulate. Length .08-.10 inch; 2-2.5 mm.

The peculiar striation of the elytra at once distinguishes this species from all others in our fauna.

Occurs in Middle States and Illinois.

P. mimeticus, n. sp.

Oblong oval, sub-depressed, surface brilliant metallic blue, legs and antennæ piceous, under surface black. Head feebly convex, sparsely punctured. Thorax equally punctured with moderate punctures with coarser punctures intermixed at the sides. Elytra sparsely punctulate, more evidently punctured at apex, subhumeral stria entire, dorsals 1-4 entire, finely punctured, fifth abbreviated at base, sutural replaced by punctures which extend slightly in front of middle. Propygidium and pygidium sparsely and finely punctured. Prosternal striæ well impressed, mesosternal stria entire. Anterior tibiæ bidentate and multidenticulate above the upper tooth. Length .06 inch; 1.5 mm. Plate V., fig. 5.

Closely allied to *æneicollis* and *dominicanus*, and differs from the first by the abbreviated fifth dorsal, and from the latter by the entire stria of mesosternum.

One specimen in cabinet of Mr. Ulke, collected in Arizona.

P. quatuordecimstriatus, Steph. Illust. Brit. Ent. V., 1832, p. 412; *nana*, Lec. Bost. Journ. V., p. 71, pl. 4, fig. 4.

Oblong oval, convex, piceous black, shining, antennæ and legs reddish-brown. Thorax sparsely punctulate, punctures at the sides coarser. Elytra with the subhumeral stria entire, striæ 1-5 entire, punctured, the fifth slightly arching at tip, and joining the entire sutural. Propygidium and pygidium sparsely punctured, the latter much more finely and sparsely. Anterior tibiæ bidentate. Length .08-.10 inch; 2-2.5 mm.

This species occurs in many parts of the world, and it is found in our own country from the Middle States to Georgia.

P. lautus, Zimm. Trans. Am. Ent. Soc., 1869, p. 253.

More elongate and convex than the preceding species. Thorax sparsely punctured, punctures moderately coarse and evenly distributed over the entire surface. Subhumeral stria entire, dorsals 1-5 entire, sutural abbreviated at base and not joining the fifth dorsal. Pygidium and propygidium sparsely and finely punctulate. Anterior tibiæ bidentate. Length .06 inch; 1.5 mm.

Occurs in North Carolina.

P. opuntiæ, Lec. Am. Lyc. V., p. 164.

Oblong oval, moderately convex, piceous black, shining. Thorax very minutely and sparsely punctulate, punctures more evident at the sides. Elytra with the subhumeral stria straight and entire, dorsals 1-4 entire, fifth abbreviated at base and continued by punctures and gradually converging toward the sutural which is also similarly abbreviated. Propygidium moderately, coarsely and sparsely punctured, pygidium minutely punctulate. Anterior tibiæ bidentate. Length .10–.12 inch : 2.5–3 mm.

Occurs at San Diego in decomposing Opuntia.

P. Tejonicus, n. sp.

Oblong, parallel, subcylindrical, piceous, legs and antennæ reddish-brown. Head sparsely punctulate, frontal stria obsolete. Thorax broader than long, slightly narrower in front, sides feebly arcuate, surface rather coarsely but sparsely punctured, marginal stria fine, entire. Elytra parallel, longer than wide conjointly, surface sparsely punctulate, subhumeral stria fine, entire, dorsals 1–5 entire, sutural more deeply impressed, abbreviated at apex and base. Propygidium coarsely and moderately densely punctured, pygidium more finely and less densely punctured. Prosternum bistriate, striæ joining at tip. Mesosternum with marginal stria entire. Anterior tibiæ finely 4-dentate, middle tibiæ with two subapical and a supra median spinule, hind tibiæ with two subapical spinules. Length entire .06 inch : 1.5 mm.

This insect resembles to a remarkable extent some of the species of Platysoma or Cylistix.

One specimen, Fort Tejon, California.

P. consors, Lec. Ann. Lyc. V., p. 164 : Mars. Mon., 1853, p. 96, pl. 8, No. 22, fig. 1.

Resembles *opuntiæ*, and differs in having the inner subhumeral stria abbreviated at base, and a short outer subhumeral visible at the middle of the sides only. The fifth dorsal and also the sutural are also more decidedly obliterated at basal end. Length .08–.10 inch : 2–2.5 mm.

Occurs with the preceding, and extends its habitat southward into Mexico, etc.

P. gilensis, Lec. Ann. Lyc. V., p. 164.

Closely resembles *consors*, but differs in having the subhumeral striæ entirely obliterated. Length .08–.10 inch : 2–2.5 mm.

Occurs in the valley of the Gila River, Arizona.

This species is not synonymous with *P. tenellus*, Er., as stated by Marseul.

P. tenellus, Er. Jahrb., 1834, p. 170 : Mars. Mon., 1853, p. 94, pl. 8, No. 22, fig. 7 : *corticalis*, Lec. Ann. Lyc. V., p. 163.

Oblong oval, depressed. Elytra with four dorsal striæ entire, fifth and sutural abbreviated at base, subhumeral very short, faintly impressed, abbreviated at apical and basal extremities. Propygidium coarsely, pygidium very finely punctulate. Length .06–.08 inch : 1.5–2 mm.

The species which we have long known as *corticalis*, Lec., agrees perfectly with the description and figure of Erichson's *tenellus*, and it is probably by an accidental error that the preceding species was placed as the synonym.

Occurs along the borders of the Colorado River, California, under bark.

P. bistriatus, Er. Jahrb., 1834, p. 171; Lec. Bost. Journ. V., p. 67. pl. 4, fig. 11; Mars. Mon., 1862, p. 26; 1861, pl. 15, No. 25, fig. 8.

Oblong oval, sub-depressed, piceous black, shining, antennæ and legs reddish-brown. Head sparsely punctured, frontal stria entire. Thorax moderately coarsely but sparsely punctured, marginal stria entire. Elytra more coarsely and sparsely punctured than the thorax, first and second striæ short basal, sutural entirely absent. Propygidium finely and sparsely punctured, pygidium more densely. Prosternum not striate. Marginal line of mesosternum distinctly impressed at middle. Anterior tibiæ finely 4-denticulate. Length .08 inch; 2 mm.

Occurs in the Middle States and Kansas.

P. seminulum, Er. Jahr., 1834, p. 171; Lec. Bost. Journ. V., p. 67, pl. 4, fig. 12; Mars. Mon., 1855, p. 120, pl. 8, No. 23, fig. 12.

Oval, moderately convex, piceous, shining. Head sparsely punctulate, frontal stria entire. Thorax sparsely punctulate, marginal stria entire. Elytra more coarsely punctured than the thorax, disc with traces of two striæ at base and a short faintly impressed sutural. Propygidium and pygidium punctulate, the latter more densely and finely. Prosternum with the striæ obsolete. Marginal stria of mesosternum broadly interrupted at middle. Anterior tibiæ finely 4-denticulate. Length .08 inch; 2 mm.

Closely allied to the preceding but the more oval and convex form as well as the presence of sutural stria at once distinguish it.

Occurs from Middle States to Texas.

DENDROPHILUS. Leach.

Antennal fossa under the side of prothorax near the middle, broadly open, pectoral plate broadly incised. Tibiæ moderately dilated, outer margins finely denticulate. Spur of anterior tibiæ large.

D. punctulatus, Say. Journ. Acad., 1825, p. 45; Lec. Bost. Journ. V., p. 65, pl. 4, fig. 8; Mars. Mon., 1857, p. 435, pl. 11, No. 30.

Piceous black, oval, moderately convex, shining. Head finely punctulate. Thorax sparsely and evenly punctulate, marginal line wanting in front, finely impressed at basal end. Elytra sparsely punctured, punctures denser toward the apex, outer subhumeral entire, deeply impressed, inner sub-obsolete; dorsal striæ 1-2 nearly entire, 3-4 gradually shorter, basal, sutural entirely wanting. Epipleuræ punctured. Progygidium very short, sparsely and finely punctulate, pygidium oval, vertical, feebly convex near the sides slightly concave, coarsely and rather densely punctured. Mesosternum deeply emarginate, without stria. Prosternum on each side striate, apex rounded, lobe short. Tibiæ similarly dilated, outer edge finely denticulate. Length .12 inch; 3 mm.

Occurs in the Middle States region, under bark.

ANAPLEUS, n. g.

Form broadly oval, convex. Head small, retracted, front slightly concave, clypeus not distinct. Antennæ frontal, inserted above the base of the mandibles, first joint moderately long, second half the length of the first, joints 3–7 small, sub-globular, equal, club suddenly formed, elongate oval, distinctly annulate. Antennal fossa in the middle of the under side of prothorax, broadly open, pectoral plate incised. Thorax without marginal stria. Scutellum very small, triangular. Elytra acutely margined. Abdomen invisible from above. Pygidium vertical or feebly inflexed. Prosternum broad, bistriate, apex feebly emarginate, lobe short sub-truncate. Mesosternum feebly prominent in front. Anterior tibiæ slightly arcuate, feebly dilated, middle and hind tibiæ slender. Tibial spurs minute.

From the insertion of the antennæ, this genus must be placed near *Dendrophilus* from which it differs by its slender middle and hind tibiæ, its shorter prosternal lobe, the mesosternum rounded in front, and many other points. From *Bacanius* it differs notably in the presence of scutellum, and from *Sphærosoma*, in which the species has been placed by the form of the antennal cavity and the form of the antennæ themselves.

A. marginatus, Lec. Proc. Acad., 1853, p. 292.

Broadly oval, regularly convex, piceous, subopaque. Head coarsely punctured, front concave. Thorax coarsely and rather densely punctured especially at base. Elytra coarsely punctured much less densely and more coarsely than the thorax, margin acute slightly reflexed, and continuous with the thoracic margin, disc with traces of the third dorsal stria at base. Propygidium short, invisible from above sparsely punctured, pygidium vertical more sparsely punctulate. Epipleural margin of elytra broad with a fine, entire line at middle. Prosternum as broad as long, on each side striate, surface moderately convex coarsely, but very sparsely punctured, lobe short sub-truncate at apex. Mesosternum broad, anteriorly rounded, surface very sparsely punctured and without striæ. Anterior tibiæ slightly arcuate, slender at base and feebly dilated toward the middle, and less dilated at apex, outer margin simple, middle and hind tibiæ slender. Spurs of anterior tibiæ minute, of middle and hind tibiæ not visible, perhaps wanting. Length .06 inch ; 1.5 mm.

The appearance of this insect is that of *Tribalus*. As in Dendrophilus the under side of the prothorax is entirely excavated and receive not only the antennæ, but also the femur and tibiæ in repose.

Occurs in Illinois and District of Columbia (Ulke).

Sub-tribe, SAPRINI.

The genera of this tribe are fewer in number than the preceding and more readily distinguished.

- Antennal cavities at the sides of the prosternum. Antennæ inserted under the frontal margin............ SAPRINUS.
- Antennal cavities on the under side of prothorax in front of the coxæ. Antennæ frontal.
  - Eyes finely granulated, not prominent.
    - Thorax without deep lateral groove.
      - Tibiæ toothed. Pygidium regularly convex...... TERETRIUS.
      - Tibiæ spinulose. Pygidium double........ ....TERETRIOSOMA.
    - Thorax with deep lateral groove. Prosternum deeply bisulcate, body oblong. Tibiæ not toothed....... PLEGADERUS.
  - Eyes coarsely granulated and very convex.
    - Hind tarsi five-jointed. Scutellum invisible......... BACANIUS.
    - Hind tarsi four-jointed.
      - Scutellum distinct.............................. ACRITUS.
      - Scutellum invisible.............................. AELETES.

Bacanius has been removed from the preceding sub-tribe and placed near Acritus with which it appears to have many points of resemblance. The eyes of the last three genera are rounder and more convex than is usual in the entire family and very coarsely granulated. The scape of the antennæ is lodged in a deep groove immediately in front of the eyes, which are not bordered by a narrow corneous band in front. The deep groove adds still further to the apparent convexity of the eyes.

SAPRINUS, Leach.

The arrangement of the species of this genus in groups, adopted by Dr. Leconte (Proc. Acad. VI., p. 40), appears to afford the most natural method of their subdivision and is, at the same time founded on characters which are much the least variable of any that can be made use of. With some slight modification to avoid the use of the epipleural striæ, the following system is identical, and the groups here retained are equivalent to those already established.

- Front not margined.
  - Hind tibiæ more slender than the middle tibiæ and at apex narrower than at middle, outer edge and apex not spinulose... Group, I.
  - Hind tibiæ as broad or broader than the middle, at apex always broader, outer edge spinulose.
    - Prosternum flat, striæ horizontal and united in front.... Group, II.
    - Prosternum at least moderately convex.
      - Prosternum without striæ............................ Group, III.
      - Prosternum distinctly striate.
        - Striæ parallel, horizontal, abbreviated in front....... Group, IV.
        - Striæ divergent and ascending.
          - Prosternum moderately convex.
            - Prosternum anteriorly not foveate.............. Group, V.
            - Prosternum foveate.......................... Group, VI.
          - Prosternum compresso-carinate.................. Group, VII.

Front distinctly margined.
  Prosternum compressed, striæ entire or nearly so, convergent in front.
    Hind tibiæ biseriately and usually finely spinulose....... Group VIII.
  Prosternum compresso-carinate, striæ short, united in front, sometimes entirely absent.
    Hind tibiæ at least triseriately often confusedly spinulose, spinules robust and frequently very short.............. Group, IX.

In the above scheme *Gnathoncus* and *Pachylopus* have been included as synonymous with *Saprinus*.

Group I.

Species of moderately robust form. Front anteriorly not margined, head with distinct supra-orbital stria extending to, and slightly on the margin of the front. Thoracic margin fimbriate. Prosternum moderately elevated, feebly convex but narrow at its summit; striæ following the slight curve of the prosternum, not ascending, broadly divergent at base, slightly divergent in front, nearly attaining the front margin of the prosternum, but not terminating in a fovea. Hind tibiæ more slender than the middle tibiæ, gradually but feebly broader from base to a little beyond the middle, then narrowed to apex, hinder margin not spinulose.

By these characters a California species may readily be separated from all our other Saprinus. The epipleural fold is also tristriate, but this character is difficult to appreciate, and is moreover uncertain in its existence.

S. discoidalis, Lec. Ann. Lyc. V., p. 167; Mars. Mon., 1855, p. 375, pl. 16, fig. 25.

Black with tinge of violet. Head sparsely and finely punctulate. Thorax at sides coarsely and densely punctured, disc smooth and shining. Elytra with the first dorsal entire, second, third, and fourth extending slightly beyond the middle and gradually obsolete, the fourth at base slightly arched, but not joining the sutural which is slightly abbreviated at base, but extends to apex and thence along the edge of the elytron to the marginal; internal subhumeral not joining the humeral, external subhumeral short, distinct at humerus only. Surface shining with an opaque space, sparsely punctured, enclosed between the first and fourth striæ extending from base to apex, and narrowly along the apex to the suture, enclosing a smooth space on the third and fourth interspaces one-fifth from the base of the elytra; discal space smooth, lateral region shining, sparsely punctulate. Propygidium and pygidium finely and rather densely punctured. Marginal stria of mesosternum entire, surface smooth. Anterior tibiæ multidenticulate, middle tibiæ uniseriately strongly spinulose, hind tibiæ mutic. Length .16-.26 inch ; 4-6.5 mm.

Occurs in Owen's Valley and San Diego, California, and also in Arizona.

Group II.

Front not margined, middle and hind tibiæ similar in form and spinulose. Prosternum horizontal, summit flat, striæ converging and united in front.

The following species are contained in this group :

Sutural stria very short, basal, not joining the fourth dorsal by an arc.
Antennal fossæ narrowing the prosternum in front........ **rotundatus.**
Sutural stria entire or nearly so, arching with the fourth dorsal ; antennal fossæ not narrowing the prosternum.
Dorsal striæ normal ; elytral sparsely punctured at apex.
Front without supra-orbital stria ; anterior tibiæ multidenticulate.. **Behrensii.**
Front with supra-orbital stria ; anterior tibiæ coarsely dentate.. **planisternus.**
Third dorsal entirely absent, elytra at apex densely strigoso-punctate abruptly limiting the discal space.... **rugipennis.**

S. rotundatus, Kugel. Schneid. Mag., p. 304 ; Mars. Mon., 1855, p. 503, pl. 19, fig. 119 ; *deletus*, Lec. Bost. Journ. V., p. 74, pl. 5, fig. 11 ; *var. communis*, Mars. Mon., 1862, p. 501, pl. 17, IV., fig. 4 ; *var. interceptus*, Lec. Ann. Lyc. V., pp. 166 and 216.

Piceous or black, shining, legs brownish-red. Head sparsely punctulate. Antennæ brownish-red. Thorax coarsely punctate and with a slight ante-scutellar impression. Elytra with the first dorsal stria entire, but very fine beyond the middle, second and fourth equal, not extending beyond the middle, third somewhat longer, fourth slightly arcuate at base, fifth represented by a very short arc sometimes uniting the fourth dorsal and sutural, the latter always very short, basal, never extending beyond the basal fourth ; subhumeral of variable length not joining the humeral ; epipleural fold with three feeble striæ ; surface sparsely punctured, punctures finer toward the sides and base. Pygidium and propygidium moderately punctured. Prosternum strongly narrowed in front, striæ gradually convergent, and uniting at the tip. Anterior tibiæ 5-denticulate, the second and third teeth more distant than the others, middle and hind tibiæ uniseriately spinulose, the latter the more finely. Length variable, .10–.14 inch ; 2.5–3.5 mm.

Var. interceptus, Lec. Elytral punctures coarser and apparently denser.

Var. communis, Mars. Punctures of the elytra more generally diffused, and more distinct in the sub-scutellar region, striæ somewhat more distinctly impressed.

I have before me a specimen of *rotundatus* from Europe, and it is from an examination of this, and a comparison of the other two forms that I feel compelled to unite them as mere varieties. In fact the variation here is not nearly so great as has been long known in *pensylvanicus* and *lugens*.

The forms identical with the European occur in the entire Atlantic region, and also in California; *communis* is Canadian, and *interceptus* from California and Oregon. An examination of Marseul's type of *communis* convinces me of the absolute identity of it with *rotundatus*.

S. Behrensii, n. sp.

Broadly oval, piceous black, shining. Antennæ and legs reddish-brown. Head finely punctulate. Thorax sparsely punctulate, punctures at sides denser and toward the base coarser. Elytra with the first dorsal extending three-fourths the length of the elytra, second, third and fourth equal extending beyond the middle, the fourth broadly arching at base and joining the sutural which extends nearly to the apex, subhumeral obsolete, humeral distinct and close to the first dorsal; epipleural fold with two striæ finely impressed; surface moderately coarsely but sparsely punctured at the apical third, the punctures not extending beyond the first dorsal, and at the suture extending slightly in front of middle. Pygidium and propygidium moderately punctured. Prosternal striæ strongly convergent in front and uniting before the apex, prosternum not narrowed in front and on each side a small fovea. Anterior tibiæ finely multidenticulate, middle and hind tibiæ uniseriately spinulose. Length .14 inch; 3.5 mm.

The appearance of this species agrees with Group IV., but the converging and united striæ forbid its position in this group. The prosternum in front is not narrowed as in its preceding species. This narrowing is caused by the extension of the antennal fossa, which thus becomes more anterior in *rotundatus* than in any other species of the genus. The genus *Gnathoncus* proposed by Duval for the species allied to *rotundatus* does not seem worthy of being retained. This species was sent me by Mr. Jas. Behrens from San Diego, California.

S. planisternus, Mars. Mon., 1862, p. 477, pl. 12, fig. 36.

Oval, moderately convex, surface shining, with distinct bronze lustre, legs brownish. Head sparsely punctulate. Thorax with the margin smooth, a short submarginal stria beginning in a shallow fossa near the anterior angle, and within the stria the surface sparsely punctured. Elytra sparsely punctured at apex beyond the tips of the striæ and near the suture; subhumeral striæ entirely absent, oblique humeral very fine; first dorsal extending slightly beyond the middle, 2–3–4 subequal extending to three-fourths, fourth dorsal arching at base joining the sutural which is entire. Propygidium and pygidium sparsely punctured, the latter more finely. Anterior tibiæ with the apical three teeth coarse, the upper three finer, middle and hind tibiæ spinulose. Prosternal striæ gradually convergent and uniting in front near the tip of the prosternum. Length .15 inch; 3.75 mm.

This species is one of the most distinct in our fauna. The thoracic sculpture is peculiar. Near the apical angle and equi-distant from the apical margin and sides is a slight fossa from which extends posteriorly a short stria, within which especially in front is a punctured space. The figure given by Marseul is very characteristic.

The type of this species was kindly loaned by M. Chevrolat, through the intervention of M. Aug. Sallé.

No special locality for its occurrence is known ; probably Texas.

S. rugipennis, Mars. Mon., 1855, p. 417, pl. 16, fig. 51.

Oval moderately convex, piceous, shining. Head sparsely punctured, supra-orbital stria entire, extending on the sides of the epistoma. Thorax with a narrow space of coarse punctures along the lateral margin, a few punctures at the sides of the base and a slight ante-scutellar impression. Elytra at apex densely strigoso-punctate and opaque, punctured space terminating abruptly in front, extending along the space between the first and second striæ by sparse punctures to base and also to the extreme margin at the apex ; external subhumeral stria indistinct, internal moderately long, oblique humeral finely impressed ; first dorsal short feebly impressed, second extending nearly to middle, third entirely obliterated except a rudiment at base, fourth dorsal as long as the second arching at base, joining the sutural which is entire. Propygidium and pygidium moderately densely and coarsely punctured. Prosternum horizontal, striæ convergent and uniting in front. Anterior tibiæ 5–6 denticulate, middle and hind tibiæ spinulose. Length .14 inch ; 3.5 mm.

This species at first sight has the aspect of relationship with *vitiosus*, Lec., but the form of the prosternum and the arrangement of the striæ absolutely forbid any such reference. The group is, as at present constituted, rather heterogeneous in aspect and might be divided into those species with the prosternum not narrowed in front by the prosternal fossæ, and those in which it is so narrowed, although such a course is at present unnecessary.

The unique before me (the type) was kindly loaned by Marseul, and is said to be from America. I introduce it in our fauna, that attention may be directed to it as its general aspect is that of a southern California species.

Group III.

Prosternum transversely convex, longitudinally very feebly sinuous anteriorly truncate, striæ entirely wanting. Front not margined.

S. interstitialis, Lec. Ann. Lyc. V., p. 166.

Oblong, piceous black, surface with slight bronze lustre. Head densely nctured, supra-orbital stria wanting. Thorax with the disc nearly ooth, at base narrowly, and at apex and with a broad space punctured, nctures denser at the margins and gradually finer toward the centre. st dorsal stria of elytra extending to middle, 2–3-4 sub-equal and ger, the third stria double, fourth dorsal broadly arching at base and ning the sutural which is nearly entire, internal subhumeral obsolete, humeral short, external subhumeral very short, basal, and close to the marginal stria, marginal stria strongly impressed, epipleural obsolete; surface between the striæ 1–4 sparsely punctured from the base, becoming gradually more dense toward the apex and forming a narrow space along the apex. Pygidium and propygidium moderately punctured. Anterior tibiæ 5-dentate, middle and hind tibiæ uniseriately spinulose. Mesosternal stria obsolete anteriorly. Length .12 inch; 3 mm.

The elytral punctures extend not only in the space indicated, but also along the suture and base, the sides of the elytra beyond the first stria are nearly smooth. The smooth space between the fourth dorsal and sutural is of oblong form and on each elytron more than twice as wide as long. One specimen in my cabinet has the third elytral stria single and not duplicated as in the type, and this character is not of specific value.

This species is thus far rare in California. Pl. v. fig. 6.

Group IV.

Prosternum broadly convex, striæ at base slightly divergent, then parallel or nearly so, horizontal and abbreviated in front, prosternum in front not narrowed, and on each side with a slight fovea.

The following table will aid in distinguishing the species:

- External subhumeral not distinct from the marginal stria.
  - Internal subhumeral stria entirely absent.................. pectoralis.
- External subhumeral stria distinct from the marginal.
  - Internal subhumeral distinct and moderately long.
    - Prosternum at summit moderately convex, striæ long, internal subhumeral strongly impressed................ obscurus.
    - Prosternum carinate, striæ very short, internal subhumeral very fine.................................... Floridæ.
  - Internal subhumeral replaced by a row of coarse, disconnected punctures....................................posthumus.
  - Internal subhumeral entirely absent.
    - Thorax finely and sparsely punctured at sides; elytra finely punctured....................................pæminosus.
    - Thorax coarsely punctured at the sides, elytra at apex coarsely punctured.................................. Copei.

The external subhumeral stria in this group is always very short, basal, and joined by its basal end to the marginal stria. In the case of *pectoralis* the presence of that stria is only known by the marginal being slightly deeper at base. In *posthumus* and *Floridæ* the external subhumeral is very close to although distinct from the marginal stria, in all the rest of the species the two striæ are very distinct. Increased collections will undoubtedly decrease the number of the species, two of them may however be known with certainty, *pectoralis* by the prosternal striæ long and convergent in front, and *floridæ* by the prosternum carinate between the striæ.

S. pectoralis, Lec. Ann. Lyc. V., p. 166.

Piceous black, shining; legs and antennæ reddish-brown. Head sparsely punctulate, without supra-orbital stria. Thorax sparsely and finely punctulate, punctures toward the sides denser and at the margin finer and more sparse, basal margin with very coarse punctures. Elytra with first dorsal stria extending three-fourths, 2–3–4 subequal and extending slightly beyond the middle, striæ punctured and terminating in punctures; fourth dorsal arching and joining the sutural which is very nearly entire, oblique humeral finely impressed, external subhumeral confounded with the marginal, internal entirely absent, surface moderately coarsely punctured at the apical third punctures extending slightly in front of the tips of the striæ and along the suture slightly in front of middle and becoming gradually more sparse. Pygidium and propygidium coarsely but not densely punctured, and on the former gradually finer and less dense toward the apex. Anterior tibiæ finely serrulate, middle and hind tibiæ spinulose. Prosternum moderately elevated, striæ slightly convergent toward the tip, but not attaining the tip nor united. Length .14-.16 inch; 3.5-4 mm.

This species resembles *S. Behrensii* of Group II., in all its superficial characters, but the latter has the prosternal striæ united near the middle of the prosternum. From the characters given in the synoptic table it will be seen that all the species of this group are very closely allied.

The specimens before me are the types collected at San Diego, California.

S. obscurus, Lec. Ann. Lyc. V., p. 166.

Thorax sparsely punctured, punctures gradually coarser and more dense to the extreme margin, along the basal margin still coarser and in front of scutellum a slight impression. Elytra with first stria extending three-fourths the length of the elytra, second and third equal extending two-thirds, fourth shorter and arching at base and joining the sutural which extends nearly to the tip; oblique humeral finely impressed, internal subhumeral long, not joining the humeral, external subhumeral short, visible under the humeral protuberance and joining the marginal at its basal end; surface sparsely, but not coarsely punctured at apical third, punctures gradually becoming finer and rapidly more distant and scatter over the entire surface. Propygidium and pygidium rather finely and moderately densely punctured, punctures evenly disposed over the entire surface. Anterior tibiæ finely serrulate, middle and hind tibiæ spinulose. Prosternum moderately convex, sparsely punctulate, striæ exactly parallel, horizontal, and extending three-fourths to apex. Length .16 inch; 4 mm.

The disc of the thorax is much more distinctly punctured than any species of this group.

Occurs at San Diego, California.

S. Floridæ, n. sp.

Broadly oval, piceous black, shining, legs and antennæ reddish-brown, club darker. Head sparsely punctured. Thorax nearly smooth at middle, sparsely punctured toward the sides and apex, base with coarse punctures and a faint impression opposite the scutellum. Elytral striæ faintly punctured, first dorsal extending three-fourths to apex, second nearly as long, third and fourth attaining the middle only, the latter arching at base, joining the sutural which is entire ; external subhumeral very close to the marginal, humeral oblique, internal subhumeral finely impressed attaining the tip of the first dorsal, but not joining the humeral at base ; surface very sparsely punctured, punctures extending from the apex two-thirds to base and as closely placed anteriorly as at the apex. Propygidium and pygidium closely, but not densely punctured. Anterior tibiæ finely multidenticulate, middle and hind, tibiæ finely spinulose. Prosternum strongly elevated, striæ short scarcely attaining the middle, parallel. Length .10 inch ; 2.5 mm.

This species is the only one of the group in which the prosternum is acutely elevated.

One specimen in my cabinet from Florida.

S. posthumus, Mars. Mon., 55, p. 460, pl. 18, fig. 82.

Head densely punctulate, supra-orbital stria absent. Thorax sparsely punctured at middle, sides more densely and coarsely, at base with coarser punctures, and in front of scutellum a slight impression. Elytra with first dorsal extending three-fourths to apex, 2–3–4 sub-equal, the latter arching at base, joining the sutural which extends nearly to apex ; striæ punctured ; external subhumeral very short, humeral finely impressed, external subhumeral formed of disconnected very coarse punctures ; surface at apex very coarsely but sparsely punctured, punctures extending from the first striæ to the suture, and anteriorly to the tips of the other striæ, and thence anteriorly becoming rapidly finer and more sparse. Pygidium rather densely and coarsely punctured, propygidium more finely and sparsely punctured. Prosternum very feebly convex, striæ deeply impressed, horizontal and very slightly convergent, extending four-fifths to apex. Anterior tibiæ finely denticulate, middle and hind tibiæ spinulose. Length .14.-16 inch ; 3.5-4 mm.

The external subhumeral is so short as to be with some difficulty observed. The unusually coarse elytral punctures and the disconnected internal subhumeral will at once distinguish it from any species of the group.

One specimen from Marseul in Cab. Leconte, and one in my own without special designation of locality. I have received a specimen from Mr. F. Blanchard, collected by him in Massachusetts.

S. pæminosus, Lec. Ann. Lyc. V., p. 166.

Head sparsely punctulate. Thorax very sparsely punctulate on the disc, at sides more coarsely but still sparsely, at base more coarsely and opposite the scutellum a slight impression. Elytra with first dorsal extending three-fourths, second and third equal, extending slightly beyond the middle, fourth slightly shorter and arching at base, joining the sutural which is entire ; external subhumeral short but very distinct, internal entirely absent, humeral very finely impressed; surface at apex very sparsely and rather finely punctate, becoming rapidly sparser and finer to apex. Anterior tibiæ finely serrulate, middle and hind tibiæ spinulose. Prosternum broad, moderately convex, striæ parallel, horizontal and attaining the apical four-fifths. Length .12–.14 inch; 3–3.5 mm.

Occurs at San Diego, California.

S. Copei, n. sp.

Broadly oval black, shining, legs and antennæ reddish-brown, club darker. Head moderately, neither densely nor coarsely punctured. Thorax sparsely and finely punctured at middle, more densely and very coarsely punctured toward the sides and at margin more sparsely; along the base with coarse punctures, and in front of scutellum a slight depression. Striæ of elytra coarsely punctured, first dorsal extending to apical four-fifths, second and third equal and nearly as long, fourth extending slightly beyond the middle, arching at base, and joining the sutural which is as long as the first dorsal; oblique humeral very fine, internal subhumeral entirely wanting, external subhumeral one-fifth the length of the elytra, distinctly impressed, and joining the marginal in front; surface at apical third coarsely but not densely punctured, punctures becoming rapidly finer near the base, and also near the first striæ Propygidium and pygidium coarsely and rather densely punctured, the latter much more finely at apex. Prosternum moderately convex. sparsely punctured, striæ strongly impressed, very feebly divergent in front, and very slightly ascending. Anterior tibiæ finely multidenticulate, middle and hind tibiæ finely spinulose. Length .14 inch; 3.5 mm.

By the slightly divergent and slightly ascendant prosternal striæ, this species tends toward the next group. The striæ extend four-fifths to apex. The prosternum in front has on each side a slight fovea. Among the species of the group it most closely resembles *posthumus*, from which it differs by its more coarsely punctured thorax, more finely punctured elytra, and differences in the elytral and prosternal striæ as noted above.

Dedicated to Prof. E. D. Cope, by whom it was collected in the region of Fort Bridger, Wyoming Territory.

Group V.

Prosternum broad at summit moderately convex, striæ divergent in front and ascending, but not terminating in a fovea in front. Head with distinct supra-orbital stria extending slightly along the front.

Inflexed portion of elytra bistriate; fourth dorsal not arched at base, punctured space of elytra opaque....	**alienus.**
Inflexed portion of elytra bistriate; fourth dorsal arched at base, and usually joining the sutural, punctured region not opaque.	

Fourth dorsal feebly arched at base, not joining the sutural, the latter short, rarely extending beyond the punctured region; interstrial region coarsely and densely punctured............................ lugens.

Fourth dorsal strongly arched at base, usually joining the sutural, interstrial region very slightly or not punctured.

  Sutural stria wanting at basal and apical portions, visible for a very slight extent at middle only..... imperfectus.

  Sutural stria distinctly impressed at apical portion, and joining the apical marginal stria.

    Surface metallic; interstrial spaces not punctured; prosternum strongly convex.................... pensylvanicus.

    Surface piceous or slightly bronzed; interstrial space more or less punctured; prosternum feebly convex.

      Elytral punctures aciculate or very dense......... oregonensis.

      Elytral punctures sparse and distinct.

        Internal subhumeral and humeral continuous... impressus.

        Internal subhumeral not continuous with humeral.. infaustus.

S. alienus, Lec. Ann. Lyc. V., p. 167.

Broadly oval, robust, black, with slight bronze tinge, antennæ and anterior legs reddish-brown. Head densely and coarsely punctured, supra-orbital stria distinct, not advancing across the front. Thorax with slight impression near the anterior angles, disc smooth, at sides punctured, punctures dense and coarser nearer the margin, at base with very few punctures, especially at middle. First dorsal stria of elytra extending slightly beyond the middle, second, third and fourth gradually shorter, fourth not arched at base, sutural very fine and entire; external subhumeral short, deeply impressed, not joining the marginal, humeral fine, joining the short internal subhumeral; inflexed portion of elytra with the marginal and two epipleural striæ; surface with the space between the striæ opaque, not densely punctured, the punctures and opacity following nearly the curve of the inner dorsal stria to the apex of the suture. Propygidium and pygidium moderately punctured, the latter more sparsely at apex. Anterior tibiæ finely 6-denticulate, middle and hind tibiæ finely biseriately spinulose. Prosternum smooth, feebly convex, striæ scarcely ascendant, gradually divergent in front. Length .14-.16 inch; 3.5–4 mm.

This species is one of the most readily known of the group. It had been placed in Group I., with which it has indeed considerable resemblance, and has been separated solely on account of the form of the hind tibiæ of the unique species of that Group.

Occurs at San Diego, and in Owen's Valley, California.

S. lugens, Er. Jahrb., 1834, p. 181; Lec. Bost. Journ. V., p. 21, pl. 5, fig. 4; Mars. Mon., 1855, p. 395, pl. 16, fig. 34; *californicus*, Mann. Bull, Mosc., 1843, ii, p. 259; *consimilis*, Walker, Nat. in Vancouver, 1866. p. 319.

Black moderately shining. Head rather densely punctured in front. Occiput smoother, frontal stria entire, but feeble at middle. Thorax with very feeble impression near the front angles, disc smooth, at sides with punctured space broader in front and base, continuing to the margin except near the hind angles, and narrowly along the basal margin. Elytra with moderately well defined, smooth scutellar space, and a subhumeral space also smoother, remainder of surface densely punctured, punctures becoming aciculate toward the apex; external subhumeral stria distinct, oblique humeral long, extending beyond its junction with the internal subhumeral, which is longer than the first dorsal; first and second dorsals subequal extending two-thirds the length of the elytra, third and fourth equal and slightly shorter than the preceding two, fourth dorsal rarely arched at base, and then the arch formed of punctures, sutural stria short, scarcely extending beyond the punctured space. Propygidium and pygidium rather densely and coarsely punctured. Prosternum in front moderately convex, striæ anteriorly divergent and slightly ascending. Anterior tibiæ finely denticulate, middle and hind tibiæ biseriately spinulose. Length .16–.24 inch; 4–6 mm.

Some of the smaller specimens of this species resemble *distinguendus* very closely.

A very abundant species occurring along the entire plains at the eastern base of the Rocky Mountains, and westward along almost the entire Pacific region.

S. imperfectus, Lec. Bost. Journ. V., p. 70, pl. 5, fig. 3.

Black shining. Head sparsely punctured, frontal stria entire. Thorax smooth at middle, and near the sides with a coarsely punctured space distant from the margin and with the punctures more sparse posteriorly, basal region with a few coarse punctures. Elytra at apex sparsely punctured, punctures extending in the first interstria, which is also slightly wrinkled near the base; external subhumeral distinct; oblique humeral long, bifid at tip, the outer branch joining the internal subhumeral which is slightly longer than the first dorsal; dorsals 1–2–4 subequal, extending slightly beyond the middle, third dorsal much shorter than the others, fourth dorsal slightly arched at base, sutural very short, represented by a few closely approximated punctures near the middle of the elytra. Propygidium and pygidium moderately densely and coarsely punctured, the latter slightly reflexed at the sides. Prosternum moderately convex, striæ in front divergent and slightly ascending. Anterior tibiæ finely denticulate, middle and hind tibiæ biseriately and rather coarsely spinulose. Length .18 inch; 4.5 mm.

This species, from the figure and description, appears to be closely allied to *concinnus*, Mann., from Siberia, but it has a longer third stria.

The type and only specimen known to me, was procured by Maj. Leconte from Melsheimer, by whom it was said to be from Pennsylvania, but as other insects have been obtained from the Melsheimer cabinet with erroneous localities, this might be looked upon with some suspicion.

S. pensylvanicus, Payk. Mon., p. 62, pl. 5, fig. 6; Lec. Bost. Journ. V., p. 71, pl. 5, fig. 4; Mars. Mon., 1855, p. 435, pl. 17, fig. 68.

Form broadly oval, robust, color variable from brilliant metallic-green to bronze. Head very sparsely and finely punctulate, frontal stria broadly interrupted. Thorax smooth with a few moderately coarse sparsely placed punctures along the sides distant from the margin, finer near the base, and a narrow basal series of rather coarse punctures; margin sparsely fimbriate. Elytra coarsely but sparsely punctured at the apical half, not extending to the first dorsal stria; external subhumeral distinct, humeral fine, oblique, internal subhumeral longer than the first dorsal, strongly impressed, but not joining the humeral; first dorsal extending two-thirds to apex, second shorter, third very short, but variable, sometimes subobsolete, fourth shorter than the second, broadly arching at base and joining the sutural which is entire. Pygidium and propygidium coarsely and rather densely punctured. Prosternum convex in front, striæ divergent and ascending. Anterior tibiæ coarsely serrate, middle and hind tibiæ biseriately spinulose. Length .16–.20 inch; 4–5 mm.

Occurs everywhere in the United States east of the Rocky Mountains.

S. oregonensis, Lec. Bost. Journ. V., p. 75, pl. 5, fig. 12; Mars. Mon., 1855, p. 297, pl. 16, fig. 36; *var. distinguendus*, Mars. loc. cit. p. 441, pl. 17, fig. 68; *spurcus*. Lec. Col. Kansas, 1859, p. 7; *sejunctus*, Mars. Mon., 1862, p. 449, pl. 12, fig. 10.

Black, shining, submetallic. Head sparsely punctured, stria interrupted at middle. Thorax smooth at middle, toward the sides sparsely and coarsely punctured in a narrow space, punctures finer posteriorly, margin much smoother, a few coarse punctures along the base, obsolete at middle. Sides of elytra very sparsely punctured, dorsal surface rather densely punctured at apical half, punctures variable in their extent between the striæ; external subhumeral short distinct, oblique humeral finer and joining the internal subhumeral, which is longer than the first dorsal; dorsal striæ subequal, extending slightly beyond the middle, fourth arching at base and joining the sutural, which is usually entire, sometimes interrupted near the base. Pygidium and propygidium coarsely and rather densely punctured. Prosternum broad, striæ divergent in front and scarcely ascending. Anterior tibiæ finely denticulate, middle and hind tibiæ finely biseriately spinulose. Length .12–.18 inch; 3–4.5 mm.

Var. oregonensis, Lec. (*spurcus*, Lec.), fourth dorsal stria arching at base and joining the sutural, which is entire and strongly impressed. Punctures of elytra extending to the base in the entire first interstria, and in the outer portion of the second. Oregon, Utah.

Var. distinguendus, Mars. Sutural stria as in the preceding. Punctures of the elytra extending along the first and second interstrial spaces to base. Canada, Wisconsin.

Var. sejunctus, Mars. (*oregonensis*, ‡ Mars.) Sutural stria interrupted near the base. Elytral punctures not extending forward between the striæ. New Mexico, Utah, Wyoming.

The series before me being very much larger than those seen by Marseul, I find myself compelled to unite all the above under one name. The latter variety may seem distinct by the characters given, but the extent of punctuation varies in all the forms to such a degree as to be of no value whatever in the separation of species. The interruption of the union between the fourth dorsal and sutural striæ, has caused Marseul to place *distinguendus* and *sejunctus* in separate groups. I have specimens which are true *sejunctus* in punctuation with the arc entire, and others even with the sutural interrupted on one side and entire on the other, in fact every conceivable variation between *distinguendus*, the most densely punctured form, and *sejunctus* on the other extreme.

This is an abundant species, occurring from Arizona to Oregon, and along the eastern base of the Rocky Mountains, and eastwardly to Canada.

S. impressus, Lec. Bost. Journ. V., p. 74, pl. 5, fig. 10.

Black, shining, legs piceous. Head very sparsely punctulate, frontal stria interrupted at middle. Thorax at anterior angles slightly impressed, disc smooth, sides coarsely punctured to the extreme margin, base coarsely punctured and slightly impressed opposite the scutellum. Elytra sparsely punctured at apex, punctures sparsely extending to base along the first interstria, which is also wrinkled near the base; external subhumeral short, humeral oblique, finely impressed, joining the internal subhumeral, which is slightly longer than the first dorsal; the latter extending two-thirds to apex, and equal to the third, second slightly longer, fourth shorter than the third and arching at base, joining the sutural which is entire. Propygidium and pygidium coarsely and rather densely punctured, the latter more sparsely at apex. Prosternum moderately broad, striæ slightly divergent at apex and not ascending. Anterior tibiæ minutely denticulate, middle and hind tibiæ finely biseriately spinulose. Length .14 inch; 3.5 mm.

Two specimens, Georgia.

S. infaustus, Lec. Proc. Acad., 1852, p. 40; *piceus*, ‖ Lec. Bost. Journ. V., p. 73. pl. 5, fig. 8.

Piceous, shining. Head sparsely punctate, frontal stria wanting. Thorax smooth at middle, sparsely punctured at sides and base, and slightly impressed at the anterior angles. Elytra sparsely punctured at apical half, punctures sparsely extending to base of first interstria; external subhumeral scarcely evident, oblique humeral very fine, widely separated from the internal subhumeral, which is strongly impressed and longer than the first dorsal, the latter extending three-fourths to apex, striæ 2–3–4 subequal, slightly shorter than the first; fourth arching at base, joining the entire sutural. Pygidium and propygidium moderately coarsely, but not densely punctured. Prosternum broad, sparsely punctured, striæ deeply impressed, slightly divergent in front and scarcely ascending. Legs brownish red. Anterior tibiæ finely and distantly denticulate, middle and hind tibiæ finely biseriately spinulose. Length .10 inch; 2.5 mm.

Closely allied to the preceding species, differing in its smaller size, scarcely evident external subhumeral and the disconnected internal subhumeral.

One specimen, Pennsylvania.

I have seen specimens from Oregon and Vancouver, differing from the unique of *infaustus* in having the external subhumeral somewhat more distinct, and by the form more regularly oval. I do not feel inclined to separate them at present, as I find no tangible character on which to found a specific distinction.

Group VI.

Prosternum more or less convex at summit, striæ entire, divergent in front, terminating in a fovea. Supra-orbital stria rarely present. Thorax rarely fimbriate.

The species are more numerous than in the preceding groups, and are distinguished in the following manner:

Pygidium with a deep marginal groove.
Groove following the entire apical and lateral margins.. æneicollis.
Groove at apex only.................................. .... assimilis.
Pygidium not grooved.
Thorax not ciliate at the sides.
Elytra punctured at apex, and thorax at sides, only.
Elytra densely aciculately punctured, striæ short. cubæcola.
Elytra sparsely punctured, striæ moderately long.
Fourth dorsal and sutural united, the latter strongly impressed at base.
Sutural stria continued by punctures to apex, elytra at apex rather coarsely punctured.
External subhumeral short, distinct...... conformis.
External subhumeral stria entirely absent.
Dorsal striæ hooked at base............ placidus.
Dorsal striæ simple.............. . .... vescus.
Sutural stria entire, usually joining the apical line.
Dorsal striæ 1–3 hooked at base; thorax distinctly punctured at sides.......... parumpunctatus.

Dorsal striæ not hooked at base; thorax very minutely punctulate.
Sutural stria not joining an apical line, the latter obliterated at middle....... **convexiusculus.**
Sutural stria continued by an entire apical line.............................. **minutus.**
Fourth dorsal arched at base, sutural interrupted at base.
Sutural stria moderately deeply impressed, abbreviated at base only.
Color piceous; pygidium smooth at apex. **scissus.**
Color, brownish; pygidium sparsely punctured................................ **scrupularis.**
Sutural stria very feeble, interrupted at base and apex................................ **wacoensis.**
Elytra more or less punctured over the entire surface; thorax either densely punctured over the entire surface or punctured as strongly at middle as at the sides.
Fourth dorsal joining the sutural by a strong arc; pygidium moderately convex.
Sutural stria feeble at base; thorax sparsely punctured................................ **laridus.**
Sutural stria strongly impressed; thorax rather densely punctured........................ **insertus.**
Fourth dorsal simply hooked at base; pygidium strongly convex, apical portion inflexed at a right angle to the superior portion........... **æquipunctatus.**
Thorax ciliate at the sides; head coarsely punctured; sutural stria interrupted at base........... **ciliatus.**

From the construction of the above table it will be inferred that the species are very closely allied, and it is probable that collections made across the continent will unite some of those, not only in this but also in other groups, which are separated on trifling characters, which are really more geographical than entomological. I have united three species under the name *insertus*, to avoid the other alternative of giving nearly every specimen a name.

S. æneicollis, Mars. Mon., 1855, p. 424, pl. 17, fig. 56; Horn, Trans. Am. Ent. Soc., 1870, p. 141.

Form moderately robust, surface metallic, thorax dark, elytra greenish-blue. Head moderately densely punctured, front slightly impressed, without stria. Thorax impressed at the anterior angles, disc smooth, at sides coarsely punctured, punctures more dense in front, margin comparatively smooth. External subhumeral stria short but distinct, humeral oblique moderately impressed, internal subhumeral deeply impressed, apical, not joining the humeral; first dorsal long, extending three-fourths to apex, second shorter, continued by regular punctures, third short, basal, continued by irregular punctures, fourth as long as second, and similarly continued, broadly arching at base and joining the sutural, which is entire, but rather feebly impressed at its basal portion; between the fourth and sutural an irregular row of punctures extending slightly in front of middle forming a *quasi* fifth stria; surface of elytra at apex moderately coarsely but sparsely punctured; punctures coarser near the suture, and extending more anteriorly. Propygidium and pygidium densely and coarsely punctured, the latter somewhat aciculate, and with the entire margin surrounded by a deep groove. Body beneath black, legs piceous. Anterior tibiæ multidenticulate, middle and hind tibiæ biseriately spinulose. Prosternum moderately elevated, but not carinate, striæ divergent in front and strongly ascendent, terminating on each side in front in a fovea. Length .18 inch; 4.5 mm.

One specimen from Texas. Resembles *pensylvanicus* at first sight, but may be known from every other Saprinus in our fauna by the entire marginal groove of the pygidium. The entire surface of the elytra has a few punctures over the entire surface, but very distantly placed.

S. assimilis, Payk. Mon. p. 63, pl. 5, fig. 7; Mars. Mon., 1855, p. 431, pl. 17, fig. 60; *extraneus*, Knoch. Illig. Mag. VI., p. 34.

Broadly oval, black, shining. Head sparsely punctulate, supra-orbital stria obsolete. Thorax impressed near the anterior angles, disc smooth, sides coarsely and densely punctured, margin smoother, base with very few punctures and distinctly impressed in front of scutellum. Elytra coarsely punctured at apex, punctures extending in the sutural region to the middle; external subhumeral stria short, deeply impressed, close to the marginal; humeral oblique not joining the internal subhumeral, which is rather deeply impressed and terminating in punctures at apex; first dorsal extending three-fourths to apex, second somewhat shorter, third and fourth equal shorter than the second, and terminating in coarse punctures; fourth stria joining the sutural which is deeply impressed at basal portion, gradually becoming more feeble, and not attaining the apex; apical marginal stria wanting. Propygidium and pygidium coarsely and rather densely punctured, the latter with a deep marginal groove at apex, and a slight impression at tip. Anterior tibiæ finely multidenticulate, middle and hind tibiæ biseriately spinulose, the posterior the more finely. Prosternum smooth, broadly convex, striæ strongly ascending, terminating on each side in a fovea. Length .16–.20 inch; 4–5 mm.

Occurs from the Middle States to Texas.

S. cubæcola, Mars. Mon., 1855. p. 167, pl. 18, fig. 88; Horn, Trans. Am. Ent. Soc., 1870, p. 140.

Black, shining. Head sparsely punctured, occiput slightly impressed, supra-orbital stria subobsolete. Thorax smooth, at anterior angles broadly impressed, at sides punctured, coarsely in front, more finely and sparsely toward the base and the extreme margin, basal margin with a line of coarse punctures. Elytra densely aciculately punctured at apical two-thirds, punctures extending to the bases of all the interstriæ except the inner; external subhumeral close to the marginal, short, humeral slightly oblique, internal subhumeral represented by a few punctures; first dorsal extending beyond the middle, striæ 2–3–4 short, subequal, fourth arching at base joining the sutural, which is entire and continuous with the apical marginal. Propygidium coarsely, but sparsely punctured. Pygidium convex, sides slightly reflexed, surface coarsely and moderately densely punctured. Anterior tibiæ finely denticulate, middle and hind tibiæ biseriately spinulose. Prosternal striæ divergent, strongly ascending, terminating in front in a fovea. Length .16 inch; 4 mm.

One specimen in my cabinet from Key West, others will probably occur in Florida.

S. conformis, Lec. Bost. Journ. V., p. 72, pl. 5, fig 7; Mars. Mon., 1855, p. 484, pl. 18, fig. 143.

Black, shining. Head sparsely punctulate, supra-orbital stria entirely wanting. Thorax smooth at middle punctured at the sides to the extreme margin, punctured space narrowest at middle. Elytra coarsely but not densely punctured at apex, punctures forming an irregular triangular space, extending at suture slightly in front of middle; external subhumeral short, close to the marginal, humeral very fine, internal subhumeral short, subapical and moderately deeply impressed; first dorsal extending four-fifths to apex, 2–3–4, gradually shorter, the fourth arched, joining the sutural which extends two-thirds to apex and thence continued by punctures; apical marginal line obliterated near the suture. Pygidium and propygidium densely and coarsely punctured. Anterior tibiæ finely denticulate, middle biseriately spinulose, hinder spinulose at apex only. Prosternum strongly convex, striæ divergent in front, ascending, terminating in a fovea anteriorly. Length .10–.12 inch; 2.5–2 mm.

Occurs from Pennsylvania to Georgia.

S. placidus, Er. Jahrb., 1834, p. 180; Mars. Mon., 1857, p. 444, pl. 11, No. 33, fig. 108 bis; *[illegible]*, Lec. Proc. Acad. 1859, p. 315.

Black, shining. Head finely punctulate, supra-orbital stria subobsolete. Thorax smooth at middle, sparsely punctured at the sides. Elytra sparsely but rather coarsely punctured at the apical third; external subhumeral stria absent, humeral fine, internal subhumeral, short apical, separated from the humeral; first dorsal deeply impressed in its entire length, extending beyond the middle, second somewhat longer, gradually less deeply impressed to tip, third and fourth sub-equal, the latter arching at base, joining the sutural which does not attain the tip of the elytra; apical marginal line obsolete at middle. Propygidium sparsely punctured, pygidium sparsely punctured at base, gradually becoming shorter at apex. Prosternum rather acutely convex, striæ divergent and ascending. Legs piceo-rufous, anterior tibiæ finely denticulate, middle and hind tibiæ finely biseriately spinulose. Length .08–.10 inch; 2–2.5 mm.

Occurs in Georgia and Missouri. Closely allied to *conformis*, but differs by the absence of the external subhumeral, and the thorax much more finely punctulate at the sides. It is compared by Marseul to *neglectus*, with what it appears to have very little in common. *S. latubris*, Lec., is a variety with the internal subhumeral reduced to a point.

S. vescus, Mars. Mon., 1855, p. 488, pl. 17, fig. 106.

Oblong oval, black, shining, moderately convex. Head sparsely and finely punctured. Thorax sparsely punctured at the sides, and with a row of coarse punctures along the base. Elytra sparsely and moderately coarsely punctured at the apical half, punctures extending between the striæ; external subhumeral stria entirely absent, oblique humeral moderately impressed; internal subhumeral short apical; dorsal striæ deeply impressed and punctured, first dorsal extending four-fifths to apex, and at tip approaching the second dorsal, second and third nearly equal, slightly shorter than the first, fourth somewhat shorter than the third, arching, at base joining the sutural which extends three-fourths to apex. Propygidium moderately densely punctured, pygidium more sparsely and finely punctured, gradually smoother to apex. Anterior tibiæ finely denticulate, middle and hind tibiæ finely spinulose. Length .12 inch, 3 mm.

This species is very closely allied to *placidus*, Er., but differs in its less convex form and more broadly convex prosternum. The elytral punctures are finer and more densely placed, but extend more anteriorly and also between the striæ. The striæ are also longer and not hooked at base as is always is the case in *placidus*. Marseul's figure of *vescus* is not characteristic.

Through the great liberality of M. Marseul, I have been enabled to study this unique type from his cabinet.

Occurs in Texas.

S. parumpunctatus, Lec. Col. Kansas, 1859, p. 7.

Broadly oval, castaneous, shining. Head sparsely punctured, supraorbital stria obsolete. Disc of thorax smooth, towards the sides sparsely but not densely punctulate, punctures extending along the base in a moderately wide space. Elytra sparsely punctured at apex, punctures very sparsely extending to base along the suture; external subhumeral very close to the marginal and scarcely distinct; oblique humeral moderately impressed; not joining the internal subhumeral which is feebly impressed; first dorsal extending four-fifths to apex, second and third sub-equal, very slightly shorter, fourth extending to middle, arching at base, joining the sutural which is entire; apical marginal line obliterated near the suture. Propygidium sparsely punctured, pygidium more densely and coarsely punctured except near the apex. Prosternal striæ divergent scarcely ascending. Metasternum very coarsely punctured. Anterior tibiæ finely denticulate, middle and hind tibiæ finely biseriately spinulose. Length .12 inch; 3 mm.

The dorsal striæ 1–3 are all hooked at base, or rather have a short process extending parallel with the base.

One specimen, Kansas. The pale color may, in part, be due to immaturity.

S. convexiusculus, Mars. Mon., 1855, p. 404, pl. 19. fig. 111.

Black, shining, surface with faint bronze tinge. Head punctulate, supra-orbital stria obsolete, frontal stria visible at the sides. Thorax smooth at middle, with a broad space at sides and very minutely punctulate, and at base more coarsely punctured. Elytra very sparsely punctured at apical third, punctures extending within the striæ and along the suture in front of middle; external subhumeral entirely absent, humeral line, oblique, not joining the short internal subhumeral; first dorsal extending four-fifths to apex, 2–3–4, gradually and but slightly shorter, the latter arching at base joining the sutural, which is entire, apical marginal line obsolete. Propygidium and pygidium moderately densely punctured. Prosternal striæ divergent, feebly ascending. Legs brownish-red, anterior tibiæ fine denticulate, middle and posterior finely biseriately spinulose. Length .10 inch; 2.5 mm.

One specimen from North Carolina, from the collection of the late Dr. Zimmermann.

S. minutus, Lec. Bost. Journ. V., p. 73, pl. 5, fig. 9; Mars. Mon., 1855, p. 186, pl. 18, fig. 104.

Black, with slight tinge of bronze, shining. Head, sparsely punctulate, supra-orbital striæ wanting, frontal stria obsolete at the sides. Thorax smooth at middle, very finely and sparsely punctulate towards the sides. Elytra very sparsely punctulate at the apical third, punctures extending forward along the suture, in front of the middle; external subhumeral stria wanting, oblique humeral moderately impressed, usually continuous with the external subhumeral which extends three-fourths to apex; first and second dorsals equal extending three-fourths; third extending slightly beyond middle, and fourth to middle only, joining the sutural which attains the apex, and continued by the apical line to the marginal. Propygidium and pygidium sparsely punctured. Legs rufous. Anterior tibiæ finely denticulate, middle and hind tibiæ finely biseriately spinulose. Prosternal striæ divergent and strongly ascending. Length .08 inch; 2 mm.

This species is very closely allied to the preceding, and differs principally in the longer internal subhumeral. The elytral punctures of this species are coarser and much less closely placed than in *convexiusculus*. In the "Catalogus (Gemm. and Harold) p. 789, this species is placed as synonymous with *plenus*," which it does not even remotely resemble.

Occurs in the Middle States.

S. scissus, Lec. Ann. Lyc. V., p. 168.

Piceous, shining. Vertex very minutely punctulate, clypeus rugose, supra-orbital stria obsolete, frontal visible at the sides. Thorax with a

few distant fine punctures on the disc, at sides very sparsely punctulate. Elytra sparsely punctured at apex, punctures at middle extending two-thirds to base. External subhumeral very short, humeral oblique, finely impressed, not joining the internal subhumeral which is short and deeply impressed, dorsals 1–2–3 equal, extending slightly beyond the middle, fourth shorter, arching at base, sutural deeply impressed, basal third obliterated, joining at apex the marginal line. Propygidium and pygidium sparsely and rather finely punctured. Prosternal striæ divergent and nearly horizontal. Legs brownish-red, anterior tibiæ finely denticulate, middle and hind tibiæ finely biseriately spinulose. Length .06–.08 inch; 1.5–2 mm.

One of the smallest species of Saprinus and readily known by the characters in the table. From *scrupularis* it moreover differs by the entirely smooth disc of thorax, which in that species is moderately coarsely but sparsely punctured.

Occurs in California.

S. scrupularis, Lec. Proc. Acad., 1859, p. 315.

Piceous, shining. Legs brownish-red. Head sparsely punctured, frontal stria slightly visible at the sides. Thorax very sparsely punctulate at the disc, more coarsely and densely at the sides. Elytra at apex sparsely punctured, punctures fine at apex and extending in the interstriæ and sutural space nearly to base; external subhumeral short but distinct, humeral finely impressed, internal subhumeral finely impressed, disconnected; first dorsal extending to middle, second and third somewhat longer, fourth slightly shorter than first, arched at base; sutural finely impressed, basal third obliterated, attaining the apical margin, apical line obsolete. Propygidium and pygidium sparsely and rather finely punctured. Anterior tibiæ finely denticulate, middle and hind tibiæ, finely biseriately spinulose. Length .06 inch; 1.5 mm.

Resembles *laridus*, which, however, has the sutural abbreviated at apex, and the thorax nearly as closely punctured at middle as at the sides.

Occurs in the Southern States.

S. wacoensis, n. sp.

Broadly oval, black shining. Front sparsely, clypeus more densely punctured; supra-orbital stria obsolete, frontal visible at the sides. Thorax smooth at the middle, moderate densely punctured towards the sides, margin smoother. Elytra sparsely punctured at apex; punctures forming a triangular space, the apex at the basal fourth of the suture; external subhumeral wanting, humeral fine, oblique, internal subhumeral obsolete; first dorsal extending four-fifths to apex, second and third nearly equal, slightly shorter than first, fourth extending to middle only, arched at base; sutural short, feebly impressed, apical fifth and basal third entirely obliterated. Propygidium and pygidium coarsely but not densely punctured. Prosternal striæ divergent, feebly ascending, prosternum broadly convex. Legs brownish red, anterior tibiæ finely serru-

The dorsal striæ 1–3 are all hooked at base, or rather have a short process extending parallel with the base.

One specimen, Kansas. The pale color may, in part, be due to immaturity.

S. convexiusculus, Mars. Mon., 1855, p. 404, pl. 19. fig. 111.

Black, shining, surface with faint bronze tinge. Head punctulate, supra-orbital stria obsolete, frontal stria visible at the sides. Thorax smooth at middle, with a broad space at sides and very minutely punctulate, and at base more coarsely punctured. Elytra very sparsely punctured at apical third, punctures extending within the striæ and along the suture in front of middle ; external subhumeral entirely absent, humeral fine, oblique, not joining the short internal subhumeral ; first dorsal extending four-fifths to apex, 2–3–4, gradually and but slightly shorter, the latter arching at base joining the sutural, which is entire, apical marginal line obsolete. Propygidium and pygidium moderately densely punctured. Prosternal striæ divergent, feebly ascending. Legs brownish-red, anterior tibiæ fine denticulate, middle and posterior finely biseriately spinulose. Length .10 inch ; 2.5 mm.

One specimen from North Carolina, from the collection of the late Dr. Zimmermann.

S. minutus, Lec. Bost. Journ. V., p. 73, pl. 5, fig. 9; Mars. Mon., 1855, p. 486, pl. 18, fig. 104.

Black, with slight tinge of bronze, shining. Head, sparsely punctulate, supra-orbital striæ wanting, frontal stria obsolete at the sides. Thorax smooth at middle, very finely and sparsely punctulate towards the sides. Elytra very sparsely punctulate at the apical third, punctures extending forward along the suture, in front of the middle; external subhumeral stria wanting, oblique humeral moderately impressed, usually continuous with the external subhumeral which extends three-fourths to apex ; first and second dorsals equal extending three-fourths; third extending slightly beyond middle, and fourth to middle only, joining the sutural which attains the apex, and continued by the apical line to the marginal. Propygidium and pygidium sparsely punctured. Legs rufous. Anterior tibiæ finely denticulate, middle and hind tibiæ finely biseriately spinulose. Prosternal striæ divergent and strongly ascending. Length .08 inch; 2 mm.

This species is very closely allied to the preceding, and differs principally in the longer internal subhumeral. The elytral punctures of this species are coarser and much less closely placed than in *convexiusculus*. In the "Catalogus (Gemm. and Harold) p. 789, this species is placed as synonymous with *planus*," which it does not even remotely resemble.

Occurs in the Middle States.

S. scissus, Lec. Ann. Lyc. V., p. 168.

Piceous, shining. Vertex very minutely punctulate, clypeus rugose, supra-orbital stria obsolete, frontal visible at the sides. Thorax with a

few distant fine punctures on the disc, at sides very sparsely punctulate. Elytra sparsely punctured at apex, punctures at middle extending two-thirds to base. External subhumeral very short, humeral oblique, finely impressed, not joining the internal subhumeral which is short and deeply impressed, dorsals 1–2–3 equal, extending slightly beyond the middle, fourth shorter, arching at base, sutural deeply impressed, basal third obliterated, joining at apex the marginal line. Propygidium and pygidium sparsely and rather finely punctured. Prosternal striæ divergent and nearly horizontal. Legs brownish-red, anterior tibiæ finely denticulate, middle and hind tibiæ finely biseriately spinulose. Length .06–.08 inch; 1.5–2 mm.

One of the smallest species of Saprinus and readily known by the characters in the table. From *scrupularis* it moreover differs by the entirely smooth disc of thorax, which in that species is moderately coarsely but sparsely punctured.

Occurs in California.

S. scrupularis, Lec. Proc. Acad., 1859, p. 315.

Piceous, shining. Legs brownish-red. Head sparsely punctured, frontal stria slightly visible at the sides. Thorax very sparsely punctulate at the disc, more coarsely and densely at the sides. Elytra at apex sparsely punctured, punctures fine at apex and extending in the interstriæ and sutural space nearly to base; external subhumeral short but distinct, humeral finely impressed, internal subhumeral finely impressed, disconnected; first dorsal extending to middle, second and third somewhat longer, fourth slightly shorter than first, arched at base; sutural finely impressed, basal third obliterated, attaining the apical margin, apical line obsolete. Propygidium and pygidium sparsely and rather finely punctured. Anterior tibiæ finely denticulate, middle and hind tibiæ, finely biseriately spinulose. Length .06 inch; 1.5 mm.

Resembles *laridus*, which, however, has the sutural abbreviated at apex, and the thorax nearly as closely punctured at middle as at the sides.

Occurs in the Southern States.

S. wacoensis, n. sp.

Broadly oval, black shining. Front sparsely, clypeus more densely punctured; supra-orbital stria obsolete, frontal visible at the sides. Thorax smooth at the middle, moderate densely punctured towards the sides, margin smoother. Elytra sparsely punctured at apex; punctures forming a triangular space, the apex at the basal fourth of the suture; external subhumeral wanting, humeral fine, oblique, internal subhumeral obsolete; first dorsal extending four-fifths to apex, second and third nearly equal, slightly shorter than first, fourth extending to middle only, arched at base; sutural short, feebly impressed, apical fifth and basal third entirely obliterated. Propygidium and pygidium coarsely but not densely punctured. Prosternal striæ divergent, feebly ascending, prosternum broadly convex. Legs brownish red, anterior tibiæ finely serru-

late, middle and hind tibiæ finely biseriately spinulose. Length .10 inch; 2.5 mm.

This species in its general aspect resembles *convexiusculus*. It is the only species in the group with both subhumeral striæ obliterated, and with the sutural also obsolete at base and apex.

One specimen (No. 546) collected by Mr. G. W. Belfrage, at Waco, Texas.

With the next species begins a small group in which the thorax is punctured over its entire surface, always equal (or very nearly so) at the disc and sides. The elytra are also punctured from apex to base, and like the thorax, nearly equally over the entire surface.

S. laridus, Lec. Ann. Lyc. V, p. 168.

Piceous, shining, legs brownish-red. Head rather coarsely punctured, supra-orbital and frontal striæ obliterated. Thorax coarsely, but sparsely punctured, slightly more densely at the sides, in front of scutellum slightly impressed. Elytra sparsely punctured over the entire surface, somewhat less densely at base; external subhumeral short, but distinct, humeral oblique, rather deeply impressed, separated from the internal subhumeral by a very slight space, the latter stria deeply impressed at the basal portion, extending three-fourths to apex; dorsals 1–4 sub-equal, extending slightly beyond the middle, the fourth arcuate at base joining the sutural, which is rather less impressed at basal third and apt to become obsolete and obliterated at apical fourth. Propygidium and pygidium moderately coarsely, but not densely punctured, the latter much smoother at apex. Prosternal striæ strongly divergent and slightly ascending. Anterior tibiæ minutely denticulate, middle and hind tibiæ finely biseriately spinulose. Length .06–.08 inch; 1.5–2 mm.

It is in this species that the smallest representatives of the genus Saprinus occur in our fauna. In its aspect it recalls *scissus* but differs in its punctuation and other characters as given above.

Occurs in California.

S. insertus, Lec. Ann. Lyc. V., p. 167; *obductus*, Lec., *vinctus*, Lec. *l. c.* p. 168.

Black, shining, surface with faint bronze tinge. Head moderately, densely and coarsely punctured; supra-orbital stria obliterated, frontal slightly visible at the sides. Thorax rather coarsely but not densely, and nearly equally punctured over the entire surface, punctures at sides slightly aciculate. Elytra punctured similarly to the thorax; external subhumeral confluent with the marginal; oblique humeral moderately impressed, nearly continuous with the internal subhumeral, which extends three-fourths to apex; first dorsal extending three-fourths, second slightly beyond the middle, third and fourth slightly shorter, the latter arching at base, joining the sutural, which is entire. Propygidium and pygidium densely and rather coarsely punctured. Prosternum broadly convex, punctured, striæ divergent and slightly ascending. Anterior tibiæ

S. neglectus, Mars. Mon., 1855, p. 491, pl. 18, fig. 108.

Oval, convex, surface distinctly bronzed. Head moderately punctured. Thorax moderately coarsely punctured at the sides, more finely along the apex, and with a few coarse punctures along the basal margin. Elytra rather coarsely, but sparsely punctured, punctures extending slightly in front of middle and outside of the first stria to the base; external subhumeral stria not distinct from the marginal, internal moderately long joining the humeral; first dorsal extending slightly beyond the middle, second extending two-thirds, third and fourth equal to the first, fourth arching at base with the sutural which is entire. Propygidium densely punctured, pygidium more sparsely punctured. Anterior tibiæ multidenticulate, middle and hind tibiæ spinulose. Length .12 inch; 3 mm.

This species is closely allied to those of the preceding group, with which it had been associated. The prosternum is, however, acutely carinate. In this species may be seen the rather curious tendency of the striæ to be prolonged by smooth lines between the punctures. This character is, however, much better shown in *fimbriatus*.

This species occurs in Georgia.

S. rubriculus, Mars. Mon., 1855, p. 489, pl. 18, fig. 107.

Oblong oval, moderately convex, ferruginous brown, shining. Head finely and densely punctured. Thorax sparsely punctured over the entire surface, slightly more densely at the sides. Elytra sparsely punctured, punctures coarser in front, and denser at apex, extending slightly in front of middle, and also between the striæ; external subhumeral absent, internal short apical; first dorsal extending two-thirds the length of the elytra, 2–3–4 gradually shorter, the latter arching at base, sutural attaining the apex interrupted at base, continued by fine punctures to the arch of the fourth dorsal. Pygidium moderately convex densely and moderately coarsely punctured. Anterior tibiæ 5–6 denticulate, middle and hind tibiæ spinulose. Prosternum carinate, striæ very indistinct. Prosternal fossæ linear uniting at the summit of the carina in front. Length .09 inch; 2.25 mm.

The type of this species is before me, and although not properly authenticated as far as habitat is concerned, is introduced into the present essay from its decidedly American aspect. From all the species of Saprinus in our fauna it may be distinguished by the curious form of the prosternal fossæ in which the striæ terminate. In place of being merely rounded pits as is usual when they occur, these fossæ are linear and extend to the summit of the prosternal carina parallel with the anterior margin of the lobe, which is also more prolonged than is usual in the genus. The interrupted sutural stria is also peculiar to this species in the present group.

One specimen, locality doubtful.

S. vitiosus, Lec. Ann. Lyc. V., p. 169.

Oval, convex, brownish, surface distinctly bronzed. Head moderately densely punctured, frontal stria slightly interrupted at middle. Thorax with fimbriate margin, surface minutely and very sparsely punctured on the disc, much more densely and coarsely at the sides, and with a row of coarse punctures along the base. Elytra densely punctured at apex, punctured space nearly limited in front and extending equally densely along the interstrial spaces to base, except a space near the base between the third and fourth; external subhumeral coincident with the marginal, internal moderately long, joining the humeral; first dorsal confused at base extending beyond the middle, second distinct equal to the first, third entirely obliterated, rarely a rudiment at base or a few punctures, fourth dorsal extending to middle, arching at base, joining the sutural which is entire. Propygidium and pygidium coarsely and moderately densely punctured. Anterior tibiae finely 6–7 denticulate, middle and third tibiae spinulose. Length .10–.14 inch; 2.5–3.5 mm.

The extra-scutellar impunctured space varies in extent. All the specimens agree in the entire obliteration of the third dorsal. This species and [illegible] have a remarkable superficial resemblance, but differ in the structure of the prosternum.

Occurs from Owen's Valley, California, southward to Cape San Lucas; also in Arizona.

S. lubricus, Lec. Ann. Lyc. V., p. 169; Mars. Mon., 1855, p. 410, pl. 17, fig. 16; *rotundifrons*, Mars. Mon., 1862, p. 464, pl. 12, fig. 24.

Oval, moderately convex, black, shining, surface slightly bronzed. Head coarsely and moderately densely punctured, frontal stria interrupted at middle. Thorax with lateral margins fimbriate, at sides with a moderately broad and well defined space coarsely and densely punctured; punctures slightly stronger at the margins, a narrow basal space punctured. Elytra with well defined smooth space, punctures coarse and dense at apical third, extending also to the bases of the interstrial spaces and equally dense; external subhumeral absent, internal feebly impressed continuous with the humeral; first dorsal confused at base extending nearly to middle, second somewhat longer, third equal to the first, fourth equal to the second, arched at base joining the sutural which is entire and deeply impressed, sutural interspace with a row of punctures. Propygidium and pygidium densely, but not very coarsely punctured. Anterior tibiae multidenticulate, middle and hind tibiae spinulose. Length .10–.14 inch; 2.5–3.5 mm.

This is the only species of the present group in which the scutellar space is entirely surrounded by a dense punctuation. The type of *rotundifrons*, Mars., is before me, and is an exact reproduction of the type of *lubricus*.

Occurs in California, especially in the southern portion of the State.

S. plenus, Lec. Ann. Lyc. V., p. 169; *olidus*, Lec. Proc. Acad., 1859, p. 316; *pratensis*, Lec. Col. Kansas, 1859, p. 8.

Oval, convex, shining, surface distinctly bronzed. Head convex,

S. neglectus, Mars. Mon., 1855, p. 491, pl. 18, fig. 108.

Oval, convex, surface distinctly bronzed. Head moderately punctured. Thorax moderately coarsely punctured at the sides, more finely along the apex, and with a few coarse punctures along the basal margin. Elytra rather coarsely, but sparsely punctured, punctures extending slightly in front of middle and outside of the first stria to the base; external subhumeral stria not distinct from the marginal, internal moderately long joining the humeral; first dorsal extending slightly beyond the middle, second extending two-thirds, third and fourth equal to the first, fourth arching at base with the sutural which is entire. Propygidium densely punctured, pygidium more sparsely punctured. Anterior tibiæ multidenticulate, middle and hind tibiæ spinulose. Length .12 inch; 3 mm.

This species is closely allied to those of the preceding group, with which it had been associated. The prosternum is, however, acutely carinate. In this species may be seen the rather curious tendency of the striæ to be prolonged by smooth lines between the punctures. This character is, however, much better shown in *fimbriatus*.

This species occurs in Georgia.

S. rubriculus, Mars. Mon., 1855, p. 489, pl. 18, fig. 107.

Oblong oval, moderately convex, ferruginous brown, shining. Head finely and densely punctured. Thorax sparsely punctured over the entire surface, slightly more densely at the sides. Elytra sparsely punctured, punctures coarser in front, and denser at apex, extending slightly in front of middle, and also between the striæ; external subhumeral absent, internal short apical; first dorsal extending two-thirds the length of the elytra, 2–3–4 gradually shorter, the latter arching at base, sutural attaining the apex interrupted at base, continued by fine punctures to the arch of the fourth dorsal. Pygidium moderately convex densely and moderately coarsely punctured. Anterior tibiæ 5–6 denticulate, middle and hind tibiæ spinulose. Prosternum carinate, striæ very indistinct. Prosternal fossæ linear uniting at the summit of the carina in front. Length .09 inch; 2.25 mm.

The type of this species is before me, and although not properly authenticated as far as habitat is concerned, is introduced into the present essay from its decidedly American aspect. From all the species of Saprinus in our fauna it may be distinguished by the curious form of the prosternal fossæ in which the striæ terminate. In place of being merely rounded pits as is usual when they occur, these fossæ are linear and extend to the summit of the prosternal carina parallel with the anterior margin of the lobe, which is also more prolonged than is usual in the genus. The interrupted sutural stria is also peculiar to this species in the present group.

One specimen, locality doubtful.

S. vitiosus, Lec. Ann. Lyc. V., p. 169.

Oval, convex, brownish, surface distinctly bronzed. Head moderately

The dorsal striæ 1–3 are all hooked at base, or rather have a short process extending parallel with the base.

One specimen, Kansas. The pale color may, in part, be due to immaturity.

S. convexiusculus, Mars. Mon., 1855, p. 404, pl. 19. fig. 111.

Black, shining, surface with faint bronze tinge. Head punctulate, supra-orbital stria obsolete, frontal stria visible at the sides. Thorax smooth at middle, with a broad space at sides and very minutely punctulate, and at base more coarsely punctured. Elytra very sparsely punctured at apical third, punctures extending within the striæ and along the suture in front of middle ; external subhumeral entirely absent, humeral fine, oblique, not joining the short internal subhumeral ; first dorsal extending four-fifths to apex, 2–3–4, gradually and but slightly shorter, the latter arching at base joining the sutural, which is entire, apical marginal line obsolete. Propygidium and pygidium moderately densely punctured. Prosternal striæ divergent, feebly ascending. Legs brownish-red, anterior tibiæ fine denticulate, middle and posterior finely biseriately spinulose. Length .10 inch ; 2.5 mm.

One specimen from North Carolina, from the collection of the late Dr. Zimmermann.

S. minutus, Lec. Bost. Journ. V., p. 73, pl. 5, fig. 9; Mars. Mon., 1855, p. 486, pl. 18, fig. 104.

Black, with slight tinge of bronze, shining. Head, sparsely punctulate, supra-orbital striæ wanting, frontal stria obsolete at the sides. Thorax smooth at middle, very finely and sparsely punctulate towards the sides. Elytra very sparsely punctulate at the apical third, punctures extending forward along the suture, in front of the middle; external subhumeral stria wanting, oblique humeral moderately impressed, usually continuous with the external subhumeral which extends three-fourths to apex ; first and second dorsals equal extending three-fourths ; third extending slightly beyond middle, and fourth to middle only, joining the sutural which attains the apex, and continued by the apical line to the marginal. Propygidium and pygidium sparsely punctured. Legs rufous. Anterior tibiæ finely denticulate, middle and hind tibiæ finely biseriately spinulose. Prosternal striæ divergent and strongly ascending. Length .08 inch; 2 mm.

This species is very closely allied to the preceding, and differs principally in the longer internal subhumeral. The elytral punctures of this species are coarser and much less closely placed than in *convexiusculus*. In the "Catalogus (Gemm. and Harold) p. 789, this species is placed as synonymous with *plenus*," which it does not even remotely resemble.

Occurs in the Middle States.

S. scissus, Lec. Ann. Lyc. V., p. 168.

Piceous, shining. Vertex very minutely punctulate, clypeus rugose, supra-orbital stria obsolete, frontal visible at the sides. Thorax with a

few distant fine punctures on the disc, at sides very sparsely punctulate. Elytra sparsely punctured at apex, punctures at middle extending two-thirds to base. External subhumeral very short, humeral oblique, finely impressed, not joining the internal subhumeral which is short and deeply impressed, dorsals 1-2-3 equal, extending slightly beyond the middle, fourth shorter, arching at base, sutural deeply impressed, basal third obliterated, joining at apex the marginal line. Propygidium and pygidium sparsely and rather finely punctured. Prosternal striæ divergent and nearly horizontal. Legs brownish-red, anterior tibiæ finely denticulate, middle and hind tibiæ finely biseriately spinulose. Length .06–.08 inch; 1.5–2 mm.

One of the smallest species of Saprinus and readily known by the characters in the table. From *scrupularis* it moreover differs by the entirely smooth disc of thorax, which in that species is moderately coarsely but sparsely punctured.

Occurs in California.

S. scrupularis, Lec. Proc. Acad., 1859, p. 315.

Piceous, shining. Legs brownish-red. Head sparsely punctured, frontal stria slightly visible at the sides. Thorax very sparsely punctulate at the disc, more coarsely and densely at the sides. Elytra at apex sparsely punctured, punctures fine at apex and extending in the interstriæ and sutural space nearly to base; external subhumeral short but distinct, humeral finely impressed, internal subhumeral finely impressed, disconnected; first dorsal extending to middle, second and third somewhat longer, fourth slightly shorter than first, arched at base; sutural finely impressed, basal third obliterated, attaining the apical margin, apical line obsolete. Propygidium and pygidium sparsely and rather finely punctured. Anterior tibiæ finely denticulate, middle and hind tibiæ, finely biseriately spinulose. Length .06 inch; 1.5 mm.

Resembles *laridus*, which, however, has the sutural abbreviated at apex, and the thorax nearly as closely punctured at middle as at the sides.

Occurs in the Southern States.

S. wacoensis, n. sp.

Broadly oval, black shining. Front sparsely, clypeus more densely punctured; supra-orbital stria obsolete, frontal visible at the sides. Thorax smooth at the middle, moderate densely punctured towards the sides, margin smoother. Elytra sparsely punctured at apex; punctures forming a triangular space, the apex at the basal fourth of the suture; external subhumeral wanting, humeral fine, oblique, internal subhumeral obsolete; first dorsal extending four-fifths to apex, second and third nearly equal, slightly shorter than first, fourth extending to middle only, arched at base; sutural short, feebly impressed, apical fifth and basal third entirely obliterated. Propygidium and pygidium coarsely but not densely punctured. Prosternal striæ divergent, feebly ascending, prosternum broadly convex. Legs brownish red, anterior tibiæ finely serru-

late, middle and hind tibiæ finely biseriately spinulose. Length .10 inch; 2.5 mm.

This species in its general aspect resembles *convexiusculus*. It is the only species in the group with both subhumeral striæ obliterated, and with the sutural also obsolete at base and apex.

One specimen (No. 546) collected by Mr. G. W. Belfrage, at Waco, Texas.

With the next species begins a small group in which the thorax is punctured over its entire surface, always equal (or very nearly so) at the disc and sides. The elytra are also punctured from apex to base, and like the thorax, nearly equally over the entire surface.

S. laridus, Lec. Ann. Lyc. V, p. 168.

Piceous, shining, legs brownish-red. Head rather coarsely punctured, supra-orbital and frontal striæ obliterated. Thorax coarsely, but sparsely punctured, slightly more densely at the sides, in front of scutellum slightly impressed. Elytra sparsely punctured over the entire surface, somewhat less densely at base; external subhumeral short, but distinct, humeral oblique, rather deeply impressed, separated from the internal subhumeral by a very slight space, the latter stria deeply impressed at the basal portion, extending three-fourths to apex; dorsals 1–4 sub-equal, extending slightly beyond the middle, the fourth arcuate at base joining the sutural, which is rather less impressed at basal third and apt to become obsolete and obliterated at apical fourth. Propygidium and pygidium moderately coarsely, but not densely punctured, the latter much smoother at apex. Prosternal striæ strongly divergent and slightly ascending. Anterior tibiæ minutely denticulate, middle and hind tibiæ finely biseriately spinulose. Length .06–.08 inch; 1.5–2 mm.

It is in this species that the smallest representatives of the genus Saprinus occur in our fauna. In its aspect it recalls *scissus* but differs in its punctuation and other characters as given above.

Occurs in California.

S. insertus, Lec. Ann. Lyc. V., p. 167; *obductus*, Lec., *vinctus*, Lec. *l. c.* p. 168.

Black, shining, surface with faint bronze tinge. Head moderately, densely and coarsely punctured; supra-orbital stria obliterated, frontal slightly visible at the sides. Thorax rather coarsely but not densely, and nearly equally punctured over the entire surface, punctures at sides slightly aciculate. Elytra punctured similarly to the thorax; external subhumeral confluent with the marginal; oblique humeral moderately impressed, nearly continuous with the internal subhumeral, which extends three-fourths to apex; first dorsal extending three-fourths, second slightly beyond the middle, third and fourth slightly shorter, the latter arching at base, joining the sutural, which is entire. Propygidium and pygidium densely and rather coarsely punctured. Prosternum broadly convex, punctured, striæ divergent and slightly ascending. Anterior tibiæ finely multidenticulate, middle and hind tibiæ finely biseriately spinulose. Length .10–.14 inch ; 2.5–3.5 mm.

After repeated examination I am unable to find any characters on which to separate the three species in the above synonymy.

Occurs in California and Oregon.

I have in my cabinet a specimen from the Yo Semite Valley, California, which is closely allied to the preceding, differing in its less convex form, striæ longer, elytra very densely aciculately punctured at apex, and with a narrow basal space somewhat broader at the suture, nearly free of punctures. At present I do not feel warranted in giving it a name as I have never seen other than the one specimen.

S. æquipunctatus, Horn, Trans. Am. Ent. Soc., 1870, p. 140.

Oblong oval, black, feebly shining. Head moderately densely punctured, supra-orbital obsolete, frontal slightly visible at the sides. Thorax nearly equally, coarsely and rather densely punctured over the entire surface. Elytra densely punctured over the entire surface ; external subhumeral wanting, humeral fine oblique, joining the internal subhumeral which extends four-fifths to apex ; dorsal striæ straight, parallel, first extending four-fifths to apex, 2–3–4 gradually and very slightly shorter, the fourth not arcuate at base ; sutural stria feeble especially at base where it forms a slight arc within the fourth dorsal. Propygidium densely and coarsely punctured, pygidium apparently double, upper portion vertical, apical part horizontal, surface densely and coarsely punctured. Prosternum broadly convex, punctured, striæ divergent and very feebly ascending. Anterior tibiæ finely multidenticulate, middle and hind tibiæ finely biseriately spinulose. Length .12–.14 inch ; 3–3.5 mm.

This species is one of the most distinct and easily recognizable in our fauna. Pl. v. fig. 8.

Occurs near San Francisco, California.

S. ciliatus, Lec. Ann. Lyc. V., p. 168.

Broadly oval, brownish, surface with slight bronze tinge. Head densely rugoso-punctate, supra-orbital moderately distinct and frontal stria slightly visible at the sides. Thorax with the entire margin ciliate with moderately long hairs, disc sparsely punctured, sides densely and aciculately punctured to the extreme margin. Disc of elytra sparsely and finely punctured, sides and apex densely aciculately punctured ; external subhumeral short basal, humeral fine, oblique, uniting by punctures with the internal subhumeral, which extends two-thirds to apex, first dorsal extending slightly beyond the middle, third extending nearly to apex of elytra, second intermediate between the first and third, fourth extending to apical three-fourths and arched at base ; sutural finely impressed, entirely obsolete at basal fourth ; apical marginal line obsolete. Propygidium and pygidium moderately densely but not coarsely punctured. Prosternum broadly convex, striæ divergent and slightly ascending. Legs rufous, anterior tibiæ rather coarsely denticu-

S. sphæroides, Lec. Bost. Journ. V., p. 78, pl. 6, fig. 5 ; Mars. Mon., 1855, p. 719, pl. 20, fig. 154 ; *bigener*, Lec. loc. cit., p. 77, pl. 6, fig. 3.

Surface bronzed or cupreous. Head distinctly margined in front, smooth, and with a faintly marked chevron. Thorax sparsely punctured in front and at the sides, basal margin more coarsely punctured, disc smooth. Elytra punctured at apex, punctured space extending to the middle along the suture ; external subhumeral moderately long, humeral finely impressed, not uniting with the internal subhumeral ; first dorsal long, extending four-fifths to apex, and sinuate at tip ; striæ 2–3–4 gradually shorter, the latter arching at tip, joining the sutural which is entire. Propygidium moderately but not densely punctured, Anterior tibiæ coarsely denticulate, the apical three teeth much shorter than the others ; middle and hind tibiæ biseriately finely spinulose. Length .10–.14 inch ; 2.5–3.5 mm.

Occurs in the Middle States and Canada, on the banks of streams or on the sea shore.

S. seminitens, Lec., New Species, 1863, p. 61.

Surface bronzed, moderately shining. Head distinctly margined, front anteriorly rugulose. Thorax punctured and at sides finely strigose, base coarsely punctured, impunctured space short and very transverse. Elytra with large space moderately coarsely and densely punctured, extending in front of middle, and enclosing the tips of the striæ, scutellar space smooth, shining, interstrial space, sub-opaque ; external subhumeral moderate, parallel with the marginal, humeral obsolete, internal subhumeral moderately impressed ; first dorsal extending four-fifths to apex, striæ 2–3–4 gradually shorter, the latter arching at base, joining the sutural which extends two-thirds to apex. Pygidium and propygidium moderately densely and coarsely punctured. Legs reddish-brown, tibiæ as in the preceding species. Length .12 inch ; 3 mm.

One specimen, Nebraska. The interstrial space in this as in the preceding species, is impunctured.

S. ferrugineus, Mars. Mon., 1855, p. 712, pl. 19, fig. 148.

Oblong oval, moderately convex, rufo-ferruginous shining. Head smooth, front margined, and with a very faintly impressed chevron. Thorax very sparsely and finely punctured at the apex and sides, and a few coarser punctures along the base. Elytra very sparsely punctured at apex, punctures extending slightly in front of middle, external subhumeral stria absent, oblique humeral finely impressed, internal subhumeral short, disconnected ; first dorsal extending to middle, second to two-thirds, third slightly longer than the first, fourth shorter, arching at base, joining the sutural which extends slightly beyond the middle, becoming finer at apex. Pygidium moderately convex, finely punctulate. Anterior tibiæ 5–6 denticulate, hind tibiæ biseriately spinulose. Prosternum carinate, striæ approximate. Length .09 inch ; 2.25 mm.

This species is easily recognized from this excellent description and figure, by Marseul. The type is before me through the kindness of M. Marseul.

Occurs in Texas.

S. fraternus, Say. Journ. Acad., 1823, V., p. 40; Lec. Bost. Journ. V., p. 77, pl. 6, fig. 4; Mars. Mon., 1855, p. 701, pl. 19, fig. 140.

Broadly oval, convex, black, aeneous, subopaque. Head flat, front rugose at middle, and with two obsolete chevrons, stria entire. Thorax moderately densely punctured, punctures at the sides somewhat strigose, discal broad triangular space nearly smooth. Elytra densely punctured and opaque with a well-defined small scutellar mirror usually limited at the sides by the fourth dorsal; external subhumeral stria obsolete, internal entire, oblique humeral fine; first dorsal long, curved at tip, 2-3-4 extending nearly to the middle, and gradually shorter, fourth arching at base, joining the sutural which is entire, rarely somewhat confused at tip. Pygidium and progygidium very densely punctured. Anterior tibiæ 7-8 denticulate, middle and hind tibiæ spinulose. Length .14 inch; 3.5 mm.

Occurs on the Atlantic and Lake shores, abundant.

S. mancus, Say. Journ. Acad., 1823, V., p. 40; Mars. Mon., 1855, p. 706, pl. 19, fig. 143.

Broadly oval, convex, black, aeneous, subopaque. Head flat, front coarsely punctured, and with a single chevron limiting a smooth triangular space, stria entire. Thorax moderately densely punctured; punctures denser and strigose in front, and at the sides, less dense and finer on the posterior portion of the disc. Elytra densely punctured, punctures strigose, scutellar mirror not well defined; external subhumeral short, close to the marginal, internal long, nearly joining the fine oblique humeral; first dorsal long arcuate at tip, 2-3-4 attaining the middle, successively slightly shorter, fourth arching at base, joining the sutural which extends to middle, its apical portion, and also the apical marginal stria obliterated. Pygidium and propygidium densely punctured. Anterior tibiæ six-denticulate, middle and hind tibiæ spinulose. Length .10-.14 inch; 2.5-3.5 mm.

Closely allied to the preceding species, but readily distinguished by the characters above given. The scutellar mirror varies in extent as well as in degree of definition, and in some specimens is almost entirely obliterated by strigosity.

Occurs in the Northern States and Canada.

S. bigemmeus, Lec. Ann. Lyc. V., p. 169; Mars. Mon., 1855, p. 707, pl. 19, fig. 144.

Surface distinctly bronzed. Head margined anteriorly, front rugoso-punctate. Thorax broadly punctured at the sides and in front, and more coarsely punctured along the base. Elytra densely strigoso-aciculate, opaque, mirrror small, well defined; external subhumeral very short, basal humeral finely impressed, joining the internal subhumeral; first dorsal well defined, extending four-fifths to apex and sinuate at tip; second extending to middle, and finely impressed, third and fourth very finely impressed and rapidly shorter, the fourth arching at base, joining the sutural which extends two-thirds to apex, and is gradually obliterated by the punctures. Pygidium and propygidium moderately, and not densely punctured. Legs as in the preceding species. Length .08–.10 inch; 2–2.5 mm.

Occurs on the sea-coast, of California.

S. Fitchii, Mars. Mon., 1862, p, 494, pl. 13, fig. 50.

Surface distinctly bronzed. Head margined, front punctato-rugose. Thorax with a broad space at sides and apex coarsely punctured, at margin strigose, discal smooth space moderately well defined, basal margin coarsely punctured. Elytra densely and coarsely punctured, and opaque over the entire dorsal aspect, except a well defined scutellar mirror; external subhumeral obsolete, humeral fine, not joining the internal subhumeral which is moderately long; first dorsal nearly entire, well marked sinuous at tip, second short, indistinct, third obsolete, fourth very short arcuate at base, sutural entirely wanting. Propygidium and pygidium moderately but not very densely punctured. Legs as in the preceding species. Length .12 inch; 3 mm.

One of the best defined species of the group. One specimen from Lowell, Massachusetts, kindly presented by Mr. P. S. Sprague.

S. estriatus, Lec. Pacif. R. R. Rep., 1857, App. I., p. 36; Horn, Trans. Am. Ent. Soc., 1870, p. 139, pl. 1. fig. 12.

Black, subopaque. Head distinctly margined, front with one or two chevrons more or less obliterated. Thorax moderately densely punctured, and at the sides substrigose, disc with spaces of irregular form impunctured. Elytra densely and moderately coarsely punctured over the entire dorsal aspect excepting three small smooth spaces, the first humeral, and extending along the sides, the second small oval and slightly within and beneath the first, the third larger than the preceding and at one-third from the base; external subhumeral not distinct from the marginal, humeral obsolete, internal subhumeral moderately impressed, first dorsal obsolete at base, apical portion nearly entire, sinuate at tip; second, third and fourth striæ entirely wanting, sutural entirely obliterated at base, apical portion sometimes evident. Pygidium and progygidium moderately densely and finely punctured, the former with a median narrow space and apex much smoother. Legs as in *fraternus*. Length .12–.18 inch; 3–4.5 mm.

Oregon and California, not common.

Group IX.

Front distinctly margined. Prosternum compresso-carinate, striæ united in front, usually short, sometimes obsolete. Hind tibiæ with moderately coarse spinules arranged in a triple series or densely and irregularly placed.

Hind tibiæ with moderately long spinules arranged in three series ; thorax punctured or rugose at the sides.
Elytra with punctures in the apical region only.
Thorax with narrow space within the margin punctured.
Sutural stria entire ; elytral punctures coarse .... patruelis.
Thorax with wide lateral and apical space strigose ; sutural stria abbreviated .... lucidulus.
Elytra densely and coarsely punctured, except a small scutellar space not well defined ; thorax coarsely punctured over nearly the entire surface............ æneipunctatus.
Hind tibiæ with short spinules densely placed ; thorax with basal margin only punctured.
Elytra sparsely punctured at apex only.
Elytral punctures coarse ; marginal stria of mesosternum sinuous at middle......................dimidiatipennis.
Elytral punctures finer ; marginal stria of mesosternum straight.................................. gaudens.
Elytra coarsely punctured over the greater part of the surface.
Elytra punctured over the entire surface ; marginal thoracic stria not extending on the base ; anterior tibiæ moderately denticulate...................... serrulatus.
Elytra with impunctured space at base ; marginal stria of thorax extending along the base ; anterior tibiæ with two apical teeth very large............ sulcifrons.

S. patruelis, Lec. Bost. Journ. V., p. pl. fig. ; Mars. Mon., 1855, p. 711, pl. 20, fig. 147 ; *Jaceti*, Mars. loc. cit. p. 709, pl. 20, fig. 146.

Form robust, surface shining with bluish-green or slightly bronze lustre. Head distinctly margined, front smooth and with a chevron more or less marked. Thorax with a narrow band of punctures within the lateral margin extending usually along the apex ; basal margin with a narrow space coarsely punctured. Elytra very coarsely but not densely punctured at apex, punctures extending along the suture two-thirds to apex ; external subhumeral obsolete, humeral oblique, fine and long, internal subhumeral disconnected, short ; first dorsal extending slightly beyond the middle, second shorter, third as long as first, fourth shorter than the preceding, and arched at base joining the sutural. Pygidium and propygidium sparsely and not coarsely punctured, the former smoother at apex. Anterior tibiæ six-denticulate, the apical three teeth much coarser, hind tibiæ biseriately spinulose. Length .10–.14 inch ; 2.5–3.5 mm.

In this species the punctuation of the sides of the thorax varies, and its extent may be reduced to a small patch near the anterior angle.

Occurs from the Middle States to Kansas.

S. lucidulus, Lec. Ann. Lyc. V., p. 170; *barbipes*, Mars. Mon., 1857, p. 448, pl. 11, No. 33, fig. 150 b.

Oblong oval, black with slight tinge of bronze. Head distinctly margined, front smooth, with a well marked chevron. Thorax sparsely punctured on the disc, more densely at the sides and apex, where they become strigose. Elytra sparsely punctured at apex, punctures extending to the middle along the suture; external subhumeral wanting, humeral moderately impressed, joining the internal subhumeral which is moderately long: first dorsal extending two-thirds to apex slightly sinuous at tip, second and third longer, fourth shorter, arched at base joining the sutural, which extends slightly beyond the middle. Pygidium and propygidium coarsely and densely punctured. Legs as in the preceding species. Length .10 inch; 2.5 mm.

Occurs at San Diego, California.

S. æneipunctatus, Horn, Trans. Ann. Ent. Soc., 1870, p. 333.

Oblong oval, black, opaque, elytra with aeneous lustre at bottom of punctures. Head margined in front, with a faintly impressed chevron. Thorax moderately, coarsely and densely punctured over nearly the entire surface except a narrow lateral and small discal space. Elytra very densely and coarsely punctured over the entire surface except at humerus and sides, and more rarely a badly defined space on each elytron near the scutellum and beneath the arch; external subhumeral obsolete, humeral obliterated by punctures, internal subhumeral moderate; first dorsal long, indistinct, second short with an arc at base, third obsolete, fourth very short, uniting by an indistinct arc at base with the sutural, which extends very indistinctly two-thirds to apex. Propygidium and pygidium densely ond coarsely punctured. Anterior tibiæ 5 or 6-denticulate, apical three teeth very coarse; hind tibiæ distinctly triseriately spinulose. Length .12 inch; 3 mm.

The striæ of the elytra are nearly as much obliterated as in *estriatus*, from which it may be readily known by the form of prosternum and the armature of the hind tibiæ.

Occurs on the sea-coast near San Francisco, Cal.

S. dimidiatipennis, Lec. Ann. Lyc. I, p. 170; Bost. Journ. V., p. 75, pl. 6, fig. 1: Mars. Mon., 1855, p. 713, pl. 20, fig. 149; *palmatus*, Say. Journ. Acad., 1825, p. 42; Lec, loc. cit., p. 76; *desertorum* ‡, Mars. loc. cit., p. 715, pl. 20, fig. 151; *deserticola*, Mars. Mon., 1857, p. 443.

Form robust, black, shining, elytra usually black, sometimes obliquely divided, the inner portion black, the outer red. Head strongly margined, front smooth, with distinct chevron. Thorax smooth, shining with a narrow space of punctures along the base. Elytra sparsely punctured at apex, punctures extending to middle along the suture, and rarely beyond the third stria, lateral region sparsely punctured; external subhumeral moderately distinct, humeral fine, internal subhumeral not joining the humeral, and broadly interrupted at its middle; first dorsal extending to middle, second and third longer, fourth equal to the first, arching at base, joining the sutural which is entire. Pygidium and propygidium coarsely but sparsely punctured. Anterior tibiæ as in the preceding species, hind tibiæ densely and irregularly spinulose on the outer face. Length .12–.16 inch; 3–4 mm.

Occurs on the sea-coast of the Middle States region.

The two synonyms by Marseul, refer to the same insect, which is the nearly totally black form, which was given him as having come from the Rocky Mountains.

S. gaudens, Lec. Ann. Lyc. V., p. 165.

Oblong oval, black, shining, with slight tinge of bronze. Head distinctly, margined front smooth without chevron. Thorax smooth with very narrow space of punctures along the base. Elytra sparsely and moderately coarsely punctured at apex, punctures extending in front of middle; external subhumeral very close to the marginal, humeral moderately long, internal subhumeral short, disconnected; first dorsal extending slightly beyond the middle, second very nearly as long, third very short, fourth one-third the length of the elytra, arched at base, joining the sutural which is entire and deeply impressed. Pygidium sparsely and rather coarsely punctured. Tibiæ as in the preceding species, but with the first two teeth very close and the third more distant. Length .12 inch; 3 mm.

Occurs on the California sea-coast, but is rare.

S. serrulatus, Lec. Ann. Lyc. V., p. 165.

Black, moderately shining, elytra brownish opaque. Head margined, front smooth, chevron feebly marked. Thorax smooth, sparsely punctured along the basal margin. Elytra very coarsely but not densely punctured over the entire surface, except a narrow space extending from the humerus along the outer side of the first dorsal stria; external subhumeral distinct, humeral finely impressed, internal subhumeral disconnected, short; first dorsal extending to middle, second and third slightly longer, fourth shorter than the first, arching at base, joining the sutural which is entire. Pygidium and propygidium coarsely and moderately densely punctured. Anterior tibiæ 7–8-denticulate and more finely than usual in the group; hind tibiæ densely clothed with short stout spinules. Length .14 inch; 3.5 mm.

Occurs on the sea-coast at San Diego.

S. sulcifrons, Mann. Bull. Mosc.. 1843, II., p. 259; Mars. Mon., 1856, p. 101, pl. 3, No. 34, fig. 2.

Form robust, black, subopaque. Head distinctly margined, front with a feeble chevron. Thorax smooth, very convex, with a narrow line of punctures at base, marginal stria advancing along the base, and deeply impressed to the middle of each elytron. Elytra densely and coarsely punctured with smoother spaces at humerus, outer apical angle and under the arch of the fourth dorsal; marginal stria arched at base; external subhumeral confounded with the marginal, humeral fine, internal subhumeral obliterated; dorsal striæ very short indistinct, except at base where all are more or less arched, fourth joining the sutural which extends very indistinctly nearly to apex. Pygidium and propygidium densely and coarsely punctured. Anterior tibiæ with two very coarse teeth at apex, above which the tibiæ are finely serrulate; hind tibiæ stout, densely spinulose. Length .18–20 inch; 4.5–5 mm.

Occurs on the sea-coast of California.

TERETRIUS, Erichs.

Body cylindrical, prosternum emarginate at tip, receiving the mesosternum, tibiæ denticulate. Antennæ frontal, antennal fossa at the sides of thorax under the anterior angle.

Two species only occur in our fauna.

Elytra with a short, very oblique stria at base.......... obliquulus.
Elytra punctured without stria..........................americanus.

T. obliquulus, Lec. Pacif. R. R. Rep., 1857, p. 36.

Oblong robust, piceous shining. Head sparsely punctured. Thorax sparsely punctured, punctures finer and slightly more dense at the sides, marginal stria entire ending abruptly at base. Elytra sparsely punctured, punctures finer toward the sides, subhumeral space smooth, at base a short, very oblique moderately impressed stria. Pygidium moderately coarsely, but not densely punctured. Prosternum broad, broadly emarginate in front, acutely notched behind, mesosternum with entire marginal line, coarsely and sparsely punctured. Anterior and middle tibiæ 6-denticulate, hind tibiæ 4-spinose. Length .10 inch; 2.5 mm.

Occurs near Sacramento, California.

T. americanus, Lec. Proc. Acad, 1859, 316; *picipes* ‡, Lec. Bost. Journ. V., p. 79, pl. 6, fig. 6.

Oblong, moderately robust, piceous shining. Head sparsely punctured. Thorax sparsely and moderately coarsely punctured, punctures finer at the sides, marginal stria entire, extending slightly along the base very close to the margin. Elytra sparsely and moderately coarsely punctured, punctures coarser at base, subhumeral smooth space small. Pygidium and propygidium moderately coarsely but sparsely punctured. Prosternum subtruncate in front. Anterior tibiæ 5–6 denticulate, middle tibiæ more coarsely 5-dentate, hind tibiæ bispinose at apex. Length .06–.08 inch; 1.5–2 mm.

This species is very closely allied to the *picipes* of Europe, and appears to differ only in the greater distinctness of the lateral margin of thorax, and by the incurved end of the marginal stria being closer to the base so that the slight groove seen in the European form is obliterated. It is probable that with more specimens this slight difference would disappear.

Widely distributed, but appears to be rare.

TERETRIOSOMA, n. g.

Form subcylindrical, short, obtuse.

Head deeply inserted, vertex convex, front inflexed; no frontal stria.

Antennæ inserted on the front, antennal fossa broad and shallow, situated on the underside of thorax in front of the coxæ.

Prosternum short, broad, without striæ, anteriorly subtruncate, posteriorly emarginate; mesosternum prominent in front, received by the prosternum, and with entire marginal line.

Thorax nearly as long as the elytra, subquadrate, anteriorly emarginate, at base broadly rounded.

Elytra punctured. Scutellum minute.

Propygidium transverse short. Pygidium double, upper portion, transversely oval, feebly convex, inferior portion longitudinally concave, transversely scarcely convex.

Anterior tibiæ slender at base, dilated at apex, exteriorly finely serrulate with many spinulose teeth, middle and hind tibiæ similar, the latter with the spinules less densely placed. Tarsi bi-unguiculate.

This genus is closely allied to *Teretrius* and *Xiphonotus*, and apparently nearly intermediate between the two. From the former it differs especially by the double pygidium, and from the latter by the absence of the prothoracic projection in front, and the two claws to all the tarsi, and the form and armature of the tibiæ. The vertex and front are not in the same continuous curve, but the latter is flat and more strongly inflexed than the former, and longitudinally concave.

T. chalybæum, n. sp.

Form subcylindrical, short, obtuse, surface shining bluish with slight tinge of green, sparsely, equally, and not coarsely punctured, antennæ and legs reddish-brown. Thorax subquadrate, slightly broader than long, sides feebly arcuate, and slightly convergent in front. Elytra slightly longer than the thorax, and scarcely longer than wide, at base slightly impressed. Propygidium transverse, punctured similarly to the elytra. Pygidium double, basal portion more than twice as wide as long, and at distal end arcuate, surface similar in color and punctuation to the propygidium; apical portion viewed directly in front, crescentic, vertically slightly concave, transversely scarcely convex, surface piceous, less distinctly punctured and subopaque. Prosternum as broad as long, moderately convex, sparsely and coarsely punctured. Meso- and metasternum coarsely and sparsely punctured, the suture obliterated. Length .12 inch; 3 mm. Plate 5, fig. 9.

One specimen, Texas, received from Dr. Summers, of New Orleans.

PLEGADERUS, Erichs.

Plegaderus may be readily known from all the genera of Histeridæ by the structure of the prosternum. The prosternum is broad and has on each side a broad, deep channel extending from the lobe to the tip, slightly arcuate, so that the two approach slightly at middle, and also a broad transverse groove which divides the median convex portion of the prosternum into two unequal portions. The lateral grooves extend also on the meso- and metasternum, and are there divergent, running parallel with the sutures. On the outer side of the grooves, and limiting them in their entire length is a ridge more or less acute as the groove is broader, and in *P. Sayi*, the ridge approaches so closely to the lateral carina of the prosternum, especially in front that the channel which usually exists between the two ridges is entirely obliterated. In consequence of this in separating our species (Trans. Am. Ent. Soc., 1870, p. 142), I described *Sayi* as having a single sulcus on each side and *nitidus* and *fraternus* two on each side. This method of expression is however faulty and may mislead, and should therefore be lost sight of.

The following table will serve to distinguish our species :

Transverse thoracic impression usually obliterated, rarely visible at the sides ; meso-metasternal plate sparsely punctured.
  Elytral punctures round, coarse and sparsely placed....... **Barbelini.**
Transverse thoracic impression entire and moderately deep.
  Elytra strigoso-punctate................................ **transversus.**
  Elytra coarsely punctured, punctures round, not strigose.
    Body beneath coarsely and rather closely perforato-punctate.. **Sayi.**
    Body beneath very sparsely punctate.
      Transverse sulcus of prosternum scarcely broader than the lateral sulci, posterior division of prosternal carina of moderate extent, the anterior elongate oval. Thorax moderately coarsely but not densely punctured. Lateral sulcus of pronotum entire.
        Posterior portion of prosternal carina trapezoidal.. **consors.**
        Posterior portion of prosternal carina triangular..... **fraternus.**
      Transverse sulcus of prosternum very broad, wider than the lateral sulci, posterior division of prosternal carina very minute, anterior transverse. Thorax very sparsely and finely punctulate. Lateral sulcus of pronotum not attaining the base................. **nitidus.**

P. Barbelini, Mars. Mon., 1862, p. 684 ; 1861, pl. 4, No. 46, fig. 2 ; *pusillus*‡, Lec. Bost. Journ. V., p. 80, pl. 6. fig. 8 ; *Erichsonii*, Lec. List, p. 28.

Oblong oval, moderately convex, brownish, shining. Head finely and not densely punctured, front slightly concave transversely. Thorax subquadrate, slightly broader than long, base not margined, lateral groove deep, not quite attaining the basal margin, marginal space convex, not interrupted ; disc with slight trace of transverse impression at the sides near the anterior third, frequently entirely wanting ; surface sparsely punctured, marginal space more densely and coarsely. Elytra coarsely and not densely punctured, punctures round and distinct; marginal stria short, extending to middle and deeply impressed,* and at humerus a slight trace of an oblique stria. Propygidium and pygidium sparsely and moderately coarsely punctured. Anterior tibiæ finely spinulose, middle and hind tibiæ ciliate. Prosternum on each side deeply sulcate, median convex portion broadly divided transversely by a deep sulcus ciliate at bottom, anterior division broadly oval, coarsely, but sparsely punctured, posterior portion small, narrow, cariniform. Mesosternal plate coarsely but very sparsely punctured. The two sulci are united in front by a fine transverse groove parallel with, and close to the anterior margin of the prosternum. The lateral ridge of the prosternum is moderately distant from the ridge bounding the sulcus externally, and the space between them is sulciform and smooth. Length .04 inch; 1 mm.

Occurs abundantly in North and South Carolina. Marseul's name has priority by one year, and must be adopted.

P. transversus, Say. (*Hister*), Journ. Acad. V., 1825, p. 45; Lec. Bost. Journ. V., p. 80. pl. 6, fig. 7; Mars. Mon., 1856, p. 277, pl. 22, fig. 9.

Oblong oval, brown, moderately shining. Head sparsely punctured, front transversely slightly concave. Thorax slightly broader than long, marginal stria deep, lateral sulcus entire, moderately deep, gradually less impressed to base, margin convex, not interrupted, more densely punctured at the anterior angles; disc divided unequally by a moderately impressed transverse sulcus, anterior portion smaller, and more closely punctured than the posterior, punctures sparsely placed and of elongate form. Elytra strigoso-punctate, more densely near the humeral angles, at humerus a short oblique stria moderately impressed; marginal stria short basal. Pygidium coarsely and moderately densely punctured. Prosternum as in the preceding species, but with the portion behind the transverse sulcus slightly more distinct. Length .05 inch; 1.25 mm.

Occurs from Canada to Texas, more abundant in the Gulf and Southern Atlantic States.

P. Sayi, Mars. Mon., 1856, p. 269, pl. 11, No. 38, fig. 7.

Oblong oval, brownish, shining. Head sparsely punctulate, front transversely slightly concave. Thorax slightly broader than long, marginal stria moderately deep, lateral sulcus entire, marginal space convex, not interrupted, coarsely and rather densely punctured; disc unequally divided by moderately deep transverse sulcus, anterior portion more finely and densely punctured than the posterior. Elytra coarsely and rather closely punctured, suture slightly elevated, oblique humeral and one dorsal stria short, rudimentary, marginal short basal. Pygidium and propygidium densely and coarsely punctured. Metasternal plate densely and coarsely perforato-punctate. Prosternal sulci deep, broad, transverse sulcus not wider than the lateral, anterior portion of prosternum oval, coarsely punctured, posterior portion oval, truncate in front; lateral carina of prosternum confluent with the ridge limiting the sulcus before attaining the front of prosternum. Length .06 inch ; 1.5 mm.

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* Marseul calls the short stria an *internal* marginal stria, but from the position of the two striæ, I find that the short stria is really the marginal, while the other of which he speaks, composed of coarse punctures, is really a portion of the sculpture of the side pieces of the meso- and metasterna.

This species is readily known by the very coarsely perforato-punctate meso-metasternal plate.

Not common. Occurs in the Middle States.

P. consors, n. sp.

Oblong oval, black, shining. Head sparsely punctulate, front slightly concave transversely. Thorax slightly broader than long, marginal stria moderately deep, lateral sulcus moderately deep, entire, marginal space convex, sparsely punctured ; disc unequally divided by a transverse sulcus, anterior portion slightly more than half the posterior and more finely but not more densely punctured. Elytra coarsely but not densely punctured, suture slightly elevated, at base a short oblique humeral and rudimentary dorsal ; marginal stria feeble extending one-third to apex. Pygidium moderately, neither coarsely nor densely punctured. Metasternum sparsely punctured. Prosternum nearly as in *Sayi*, posterior portion of carina broader than long, trapezoidal, lateral carina of prosternum extending entirely to apex. Length .05 inch ; 1.25 mm.

Narrower and less convex than *Sayi* and with the meso-metasternal plate very sparsely punctured.

One specimen, Colorado.

P. fraternus, Horn, Trans. Am. Ent. Soc., 1870, p. 141.

Oblong oval, brownish, moderately shining. Head sparsely punctured and slightly transversely concave. Thorax slightly broader than long, marginal stria moderately deep, lateral sulcus entire, marginal space convex, sparsely punctured, more densely in front ; disc unequally divided by a transverse sulcus less distinct at middle, surface sparsely punctured, the anterior division more finely. Elytra sparsely punctured, punctures coarse, round and deeply impressed, suture slightly elevated, at base with short oblique humeral and rarely a rudimentary dorsal, marginal short moderately deeply impressed. Pygidium moderately coarsely and densely punctured. Metasternal plate sparsely punctured. Prosternum nearly as in *Sayi*, the portion behind the transverse sulcus oval, subacute in front, lateral ridge entire, the space between it and the marginal ridge of the sulcus not channeled. Length .05 inch ; 1.25 mm.

Smaller than the preceding species and relatively broader. Differs especially in the form of posterior division of the prosternum which results from a narrower transverse sulcus.

Occurs in California and Nevada.

P. nitidus, Horn, Trans. Am. Ent. Soc., 1870, p. 141.

Oblong oval, black, shining. Head sparsely punctulate, front transversely slightly concave. Thorax slightly broader than long, marginal stria moderately impressed, lateral sulcus moderately deep in front, gradually shallower behind and not attaining the basal margin, marginal space moderately convex, sparsely punctured, more densely in front, disc sparsely and finely punctured, unequally divided by transverse sulcus. Elytra frequently with two rudimentary dorsal and oblique humeral striæ, surface sparsely and rather finely punctured; marginal stria fine extending one-third. Pygidium moderately coarsely but not densely punctured. Metasternum sparsely punctured. Prosternal sulci broad, deep, transverse sulcus much broader, anterior prosternal division transversely oval, posterior small, obtusely cariniform. Length .07–.09 inch; 2–2.5 mm.

One of our most distinct species, easily known by its black, shining, sparsely and rather finely punctured surface.

Occurs in Nevada and Oregon; in the latter place collected rather abundantly by Lord Walsingham.

Bacanius, Lec.

Frontal suture distinct. Eyes coarsely granulated. First joint of antennæ gradually thicker to the tip, second joint broader than long, rhomboidal, third longer than the two following, antennal fossa as in Dendrophilus. Prosternum broader than long, at tip truncate, lobe nearly as long as the prosternum, mesosternum truncate. Anterior tibiæ dilated and bidenticulate, middle and hind tibiæ dilated, but less than the anterior.

The species of this genus are all minute and are thus distinguished:

Prosternum and mesosternum smooth sparsely punctured, mesosternal stria visible at the sides, obliterated at middle. Elytral punctures simple.

Elytra with subhumeral and first dorsal entire. Epipleural fold smooth, impunctured. Pygidium very minutely punctulate.. misellus.

Elytra with subhumeral abbreviated at apex, first dorsal short. Epipleural fold sparsely punctured. Pygidium punctured.. tantillus.

Prosternum and mesosternum coarsely foveato-punctate, mesosternal stria entirely obliterated. Subhumeral stria wanting, first dorsal entire, broadly arching at base and returning. Epipleural fold coarsely punctured. Pygidium coarsely punctured. Elytral punctures substrigose.. punctiformis.

B. misellus, Lec. Proc. Acad., 1853, p. 292; Mars. Mon., 1856, p. 573, pl. 14, No. 41, fig. 3.

Broadly oval, subglobose, brownish-red, moderately shining. Head very sparsely and minutely punctulate. Thorax sparsely and finely punctured. Elytra more coarsely punctured, punctures simple and sparsely placed, subhumeral stria entire, first dorsal entire, more deeply impressed than the subhumeral. Pygidium shining, very sparsely and finely punctulate. Meso-metasternal plate shining, very minutely punctulate. Legs paler than the under surface. Length .03 inch ; .75 mm.

Occurs in the Middle States region.

B. tantillus, Lec. loc. cit., p. 291.

Larger, more broadly oval and less convex than the preceding species. Thorax more coarsely punctured. Elytra with subhumeral stria abbreviated at base and subobsolete at apex, first dorsal apical, attaining the middle only. Pygidium coarsely punctured. Meso-metasternal plate sparsely punctured. Length .04 inch ; 1 mm.

Occurs from Pennsylvania to Louisiana.

B. punctiformis, Lec. loc. cit., p. 288.

Similar in form to *misellus*. Thorax similarly punctured. Elytra without subhumeral stria, first dorsal entire broadly arching at base, surface densely aciculately punctured and with a substrigose aspect. Pygidium coarsely but not densely punctured. Meso-metasternal plate densely foveato-punctate. Length .03 inch ; .75 mm.

Occurs in Pennsylvania, Florida, Missouri.

ACRITUS. Lec.

This genus contains the most minute species of the family. It may be at once known by the four-jointed hind tarsi. *Bacanius* bears a superficial resemblance to *Acritus*, but may be known by the five-jointed hind tarsi, the prosternum slightly lobed in front and without striæ, and the form of the tibiæ. They have in common, however, the prominent, coarsely granulated eye, in front of which the antennal scape is lodged, when at rest, in a deep groove.

The four-jointed hind tarsus results from the union of the first two joints, consequently the first joint thus formed is long, always equal to the two following united, and in the majority of cases much longer. The scutellum is small and difficult to see from the very fine sutures between it and adjacent parts, and although small it is proportionately as large as in many *Saprinus*. Several species I find to be totally deprived of scutellum between the basal angles of the elytra ; these I have separated as a distinct genus.

As thus restricted our species are as follows :

Thorax without basal transverse row of punctures.
  Anterior tibiæ rather broadly dilated. Prosternum much longer than wide at base, striæ in front strongly divergent, at base parallel.................................. **maritimus.**
  Anterior tibiæ scarcely broader than the middle.
    Prosternum scarcely longer than wide at middle ; elytra finely punctured...................................... **Arizonæ.**
    Prosternum twice as long as wide ; elytra sparsely punctured.. **exiguus.**
Thorax with basal transverse row of punctures.
  Prosternum scarcely longer than wide ; marginal striæ of mesosternum interrupted.

Basal row of punctures short, arcuate; mesosternum slightly concave longitudinally sulcate; meso-metasternal suture obliterated.......................... Floridæ.
Basal row of punctures long, nearly straight; mesosternum flat, meso-metasternal suture distinct.
Form orbicular; metasternum sparsely and finely punctured.................................. discus.
Form oval; metasternum coarsely punctured......... fimetarius.
Prosternum much (usually twice) longer than wide; mesosternal stria entire.
Elytra with very deep humeral and dorsal striæ; thorax very minutely and sparsely puncticulate........... Sallei.
Elytra with scarcely a trace of striæ; thorax moderately punctured.
Prosternal striæ not more divergent in front than at base, elytral punctures much less distinct at base. strigosus.
Prosternal striæ more divergent in front, elytral punctures as deep at base as at middle............... acaroides.

A. maritimus, Lec. Ann. Lyc. V., p. 170; Proc. Acad., 1853, p. 290.

Oblong, feebly convex, brownish-black, shining. Head sparsely punctulate. Thorax sparsely and finely punctured. Elytra moderately coarsely, but not densely punctured, punctures feebly strigose at apex; disc with faint oblique dorsal stria extending nearly to the middle of the margin; marginal stria deeply impressed, entire; suture slightly channelled at base. Pygidium smooth shining. Prosternum much longer than wide at base, striæ posteriorly parallel, anteriorly very strongly divergent, surface feebly shining, very finely alutaceous. Mesosternal stria entire. Anterior tibiæ dilated, anterior face slightly concave, outer margin finely spinulose. Length .045 inch; 1 mm.

Occurs in California. It is the largest species in our fauna. The measurement above is the entire length, and it is really more than 1 mm. long.

A. Arizonæ, n. sp.

Broadly oval, convex, brownish-black, shining. Head sparsely punctulate. Thorax sparsely punctured, punctures at apex fine, becoming gradually coarser to base. Elytra rather sparsely and moderately finely punctured, punctures finer at apex; disc with a short scarcely evident humeral and dorsal stria not attaining the base, marginal stria fine. Pygidium very sparsely punctulate. Prosternum broad, nearly as wide at middle as long, surface sparsely punctured. Mesosternum moderately punctured, marginal stria interrupted, metasternal suture distinct. Metasternum sparsely punctulate. Anterior tibiæ scarcely broader than the middle. Length .04 inch; 1 mm.

Occurs in Arizona, at Camp Grant, under Cottonwood bark.

A. exiguus, Erichs. Jahrb., 1834, p. 208; Lec. Proc. Acad., 1853, p.

291; Mars. Mon., 1856, p. 603, pl. 14, No. 11, fig. 3; *aciculatus*, Lec. Bost. Journ. V., p. 84, pl. 6, fig. 10; Mars. Mon., loc. cit., fig. 2; *obliquus*, Lec., loc. cit., fig. 12; *cribripennis*, Mars. Mon., 1856, p. 605, pl. 14, No. 43, fig. 5; *Natchez*, Mars., loc. cit., p. 604, fig. 4.

Oblong oval, brownish, slightly convex, shining. Head sparsely punctulate. Thorax moderately coarsely and sparsely punctured. Elytra more coarsely but not more densely than the thorax, marginal stria moderately deep, entire. Pygidium finely and sparsely punctulate. Prosternum more than twice as long as wide, surface with very few punctures. Mesosternal stria interrupted at middle, meso-metasternal plate rather coarsely but sparsely punctured. Anterior tibiæ slender. Length slightly less than .04 inch; 1 mm.

After a careful study of the types of all the above synonyms, I confess myself unable to separate them. *Natchez* is said to have the mesosternum with an entire marginal stria, but I am thoroughly convinced that the stria is not entire and that the appearance is entirely owing to a very slight elevation of the anterior edge of the mesosternum, against which the tip of the prosternum abuts. The presence of the dorsal stria on which *obliquus*, *aciculatus* and *cribripennis* have been founded, is a character of no value whatsoever here, as every variation occurs from a moderate stria touching the base, to a shorter stria not attaining the base, and from this to no stria at all.

Occurs not uncommonly in the Middle, Southern and Western States, under bark.

A. Floridæ, Mars. Mon., 1862, p. 693, pl. 4, No. 51, fig. 2.

Orbicular, feebly convex, piceous, shining. Head sparsely punctulate. Thorax moderately, densely, and coarsely punctured at base, with a short row of closely approximate punctures, arcuate, and terminating within the middle of the elytra. Elytra more coarsely punctured than the thorax at base; punctures less distinct, at middle and near apex slightly strigose; marginal stria fine, entire; two very short striæ at base, very feebly impressed. Pygidium finely and not densely punctured. Prosternum scarcely longer than broad, sparsely punctured. Mesosternum slightly concave, surface longitudinally sulcate, stria interrupted. Metasternum sparsely punctured, suture obliterated. Anterior tibiæ slender. Length .04 inch; 1 mm.

More elongate and convex than *discus*, but equal in size. Occurs in South Carolina, Florida (Marseul), Louisiana (Sallé).

A. discus, Lec. Proc. Acad., 1853, p. 289.

Orbicular, brownish, moderately convex, shining. Head sparsely and minutely punctulate. Thorax finely punctured, at base a transverse, nearly straight, row of punctures extending nearly to the basal angles. Elytra moderately punctured, more coarsely than the elytra and finer and slightly aciculate at apex, marginal stria fine, entire, slightly sinuous at base, and with a very faint trace of a dorsal stria. Pygidium subopaque, finely alutaceous. Prosternum scarcely longer than wide at middle, coarsely but sparsely punctured. Mesosternum flat, coarsely punctured, stria interrupted, metasternum finely alutaceous, sparsely punctured, suture fine but distinct. Legs pale rufous, anterior tibiæ slender. Length .04 inch ; 1 mm.

Occurs in Georgia, under bark.

A. fimetarius, Lec. Bost. Journ. V., p. 84 ; Mars. Mon., 1856, p. 615, pl. 14, No. 43, fig. 14.

Oval, moderately convex, piceous, shining. Head sparsely and minutely punctulate. Thorax sparsely and finely punctulate, at base a transverse, nearly straight row of punctures extending beyond the middle of each elytra. Elytra sparsely punctured, more coarsely than the thorax, at apex slightly aciculate, marginal stria entire, moderately deep. Pygidium finely transversely strigose and sparsely punctured. Prosternum scarcely longer than wide, sparsely punctured, mesosternum flat, coarsely punctured, stria interrupted, metasternum coarsely punctured, suture distinct. Anterior tibiæ slightly dilated at apex. Length .04 inch ; 1 mm.

Scarcely as long as *discus*, but more oval and convex, and with the elytra more coarsely punctured with deeper marginal stria.

Occurs in the Middle and Southern States.

A. Sallei, n. sp.

Oval, convex, brownish, shining. Head minutely punctulate. Thorax very finely and sparsely punctured, at base a short row of punctures, nearly straight close to the basal margin and not attaining the middle of the elytra. Elytra coarsely punctured, punctures finer and slightly aciculate at apex, disc with two oblique very deeply impressed striæ, the inner longer and extending to middle and between the tips of the two striæ the rudiment of another, marginal stria deep, entire. Pygidium finely alutaceous. Prosternum nearly twice as long as wide at middle, very sparsely punctured. Mesosternal stria entire, meso- and metasternum coarsely punctured, suture very fine. Anterior tibiæ slender. Length .03 inch ; .75 mm.

Closely allied to *strigosus*, but differs by the much more finely punctured thorax, deep dorsal and marginal stria. The latter stria is very much deeper at base, and there appears to be an additional stria at that point, parallel with and very close to it. In size it is equal to *strigosus*.

Georgia and Louisiana. Respectfully dedicated to M. Aug. Sallé, Paris, whose kindness during the progress of this paper has already been acknowledged.

A. strigosus, Lec. Proc. Acad., 1853, p. 289 ; Mars. Mon., 1856, p. 619, pl. 14, No. 43, fig. 19 ; *conformis*, Lec., loc. cit. ; *lateralis*, Mars. Mon., 1856, p. 621, pl. 14, No. 43, fig. 21..

Oval, moderately convex, brown, shining. Head sparsely and finely punctulate. Thorax sparsely and moderately finely punctured, and with a basal row of fine punctures not extending beyond the middle of the elytra. Elytra coarsely punctured, punctures at apex strigose, marginal stria fine, disc with or without faint traces of an oblique dorsal stria. Pygidium finely alutaceous. Prosternum nearly twice as long as wide, striæ not more divergent in front, surface with a few punctures. Meso-sternal stria entire, meso- and metasternum coarsely punctured, the latter less so, suture fine. Tibiæ slender. Length .03 inch; .75 mm.

I am totally unable to appreciate the differences between *lateralis*, Mars., and *strigosus*, Lec., and after a careful examination of the species I believe *conformis* to be merely a somewhat smoother form.

Occurs in the Southern States.

A. acaroides, Mars, Mon., 1856, p. 618, pl. 14, No. 43, fig. 18.

Oval, convex, piceous, shining. Head sparsely punctulate. Thorax finely and moderately densely punctured, basal row of punctures moderately coarse, close to the margin and short. Elytra coarsely punctured, punctures strigose at apex, marginal stria moderately deep. Pygidium extremely finely alutaceous. Prosternum longer than wide at middle, striæ divergent in front. Mesosternal stria entire, meso- and metasternum coarsely punctured, suture fine but distinct. Tibiæ slender. Length .05 inch; 1.25 mm.

I have the type alone before me. Closely allied to *strigosus*.

Occurs in the Southern States.

A. atomus, Lec., cited by Marseul from New Orleans, is from Cuba.

ÆLETES, n. g.

The absence of scutellum is the only character separating the species below from Acritus.

They are as follows:

Surface smooth, impunctured.	
Prosternum twice as long as wide....................	politus.
Prosternum nearly as wide as long..................	brevisternus.
Surface punctured. Thorax with basal row of punctures.	
Basal row of punctures short, arcuate...............	basalis
Basal row of punctures straight, long...............	simplex

A. politus, Lec. Proc. Acad., 1853, p. 290; Mars. Mon., 1856, p. 610, pl. 14, No. 43, fig. 10.

Oval, convex, brown, shining, impunctured. Prosternum twice as long as wide. Mesosternum longitudinally sulcate, stria obliterated at middle, suture not evident. Length .03 inch; slightly less than 1 mm.

Occurs in the Middle, Southern and Western States.

A. brevisternus, Mars. Mon., 1856, p. 609, pl. 14, No. 44, fig. 9.

Oval, convex, brownish, shining, impunctured. Prosternum scarcely longer than wide. Mesosternum with stria interrupted, surface nearly impunctured, suture indicated by a transverse row of coarse punctures, the punctures finer at the sides and elongate in the middle. Length .035 inch; .8 mm.

One specimen, the type, is before me. Occurs in Louisiana.

A. basalis, Lec., Ann. Lyc. V., p. 170; Proc, Acad. 1853, p. 290.

Oval, moderately convex, piceous, shining. Head sparsely and finely unctulate. Thorax moderately punctured at base with a row of punc-ures strongly arcuate at middle, and slightly prolonged along the basal argin. Elytra moderately punctured, punctures coarser than those of e thorax, marginal stria moderate. Pygidium shining, very sparsely unctulate. Prosternum as broad as long. Mesosternum with the stria terrupted, metasternum sparsely punctured. Length .04 inch; 1 mm.

The punctures forming the arcuate line of the base of the thorax are ongitudinally prolonged, and the base of the thorax is apparently sulcate.

Occurs in the region near Fort Yuma, Cal.

A. simplex, Lec. Bost. Journ. V., p. 84, pl. 5, fig. 11; Mars. Mon., 856, p. 620, pl. 14, No. 43, fig. 20; *acupictus*, Mars. loc. cit. p. 618, fig. 7.

Oval, brownish, moderately convex, shining. Head minutely punctu-te. Thorax sparsely and finely punctured, basal row of punctures ong, slightly arcuate at middle, punctures at middle sulciform. Elytra parsely punctulate, punctures fine and aciculate, marginal stria fine. ygidium smooth. Prosternum nearly as broad as long. Mesosternum nd metasternum smooth, suture indicated by a row of coarse punctures, oarser at middle. Length .04 inch; 1 mm.

I have carefully compared the types of Marseul and Leconte, and find hem identical, although *simplex* is said by Marseul to have a narrower pro-ernum. This is certainly not the case in any specimen examined by me. his and the preceding species are closely allied, but differ in the thoracic nd elytral punctuation and also by the more strongly arcuate basal line f the former.

Occurs principally in the Southern States.

EXPLANATION OF PLATE V.

IG. 1. Hister æneomicans Horn.
" 2. Tribalister marginellus Lec.
" 3. Hetærius morsus Lec.
" 4. Echinodes setiger Lec.
" 5. Paromalus mimeticus Horn.
FIG. 6. Saprinus interstitialis Lec.
" 7. " Copei Horn.
" 8. " æquipunctatus Horn.
" 9. Teretriosoma chalybæum Horn.

INDEX.

(Synonyms are in *italics.*)

Acritus Lec. 352
- acaroides *Mars*. 356
- *aciculatus Lec*. 354
- Arizonæ *Horn*. 353
- atomus *Lec*. 356
- *conformis Lec*. 355
- *cribripennis Mars*. 354
- discus *Lec*. 354
- exiguus *Erichs*. 353
- fimetarius *Lec*. 355
- Floridæ *Mars*. 354
- *lateralis Mars*. 355
- maritimus *Lec*. 353
- *Natchez Mars*. 354
- *obliquus Lec*. 354
- Sallei *Horn*. 355
- strigosus *Lec*. 355

Æletes Horn. 356
- *acupictus Mars*. 357
- basalis *Lec*. 357
- brevisternus *Mars*. 356
- politus *Lec*. 356
- simplex *Lec*. 357

Anapleus Horn. 311
- marginatus *Lec*. 311

Bacanius Lec. 351
- misellus *Lec*. 351
- punctiformis *Lec*. 352
- tantillus *Lec*. 352

Cylistix Mars. 298

Dendrophilus Leach. 310
- punctulatus *Say*. 310

Echinodes Zimm. 305
- setiger *Lec*. 305

Epierus Erichs. 300
- *decipiens Lec*. 301
- ellipticus *Lec*. 301
- *minor Lec*. 301
- nasutus *Horn*. 301
- *nigrellus Say*. 300
- novellus *Zimm*. 300
- planulus *Erichs*. 301
- pulicarius *Erichs*. 301

Epierus—Continued
- regularis *Beauv*. 300
- *vicinus Lec*. 300

Hetærius Erichs. 304
- brunnipennis *Rand*. 304
- californicus *Horn*. 304
- morsus *Lec*. 303

Hister *Linn*. 278

Hister Mars. 280
- abbreviatus *Fab*. 286
- æneomicans *Horn*. 295
- æquus *Lec*. 297
- ambigena *Lec*. 293
- americanus *Payk*. 293
- arcuatus *Say*. 281
- *Arizonæ Horn*. 283
- attenuatus *Lec*. 298
- aurelianus *Horn*. 297
- basalis *Lec*. 298
- *bifidus Say*. 286
- bimaculatus *Linn*. 292
- biplagiatus *Lec*. 282
- carolinus *Payk*. 296
- civilis *Lec*. 286
- coarctatus *Lec*. 297
- cœnosus *Erichs*. 286
- curtatus *Lec*. 291
- cylindricus *Payk*. 298
- *cylindricus Beauv*. 298
- *decisus Lec*. 286
- defectus *Lec*. 291
- *depressus* ‡ *Lec*. 297
- depurator *Say*. 290
- dispar *Lec*. 290
- *elongatus Beauv*. 298
- exaratus *Lec*. 293
- *frontalis* ‖ *Say*. 297
- furtivus *Lec*. 290
- Gloveri *Horn*. 282
- gracilis *Lec*. 299
- guttifer *Horn*. 279
- Haldemanni *Mars*. 291
- *Harrisii Kby*. 284

HISTER—Continued
- *hospitus Lec.* 290
- immunis *Erichs.* 285
- incertus *Mars.* 290
- indistinctus *Say.* 291
- instratus *Lec.* 282
- interruptus *Beauv.* 294
- lævipes *Germ.* 285
- Lecontei *Mars.* 297
- lucanus *Horn.* 283
- *memnonius Say.* 283
- merdarius *Hoffm.* 284
- militaris *Horn.* 290
- nubilus *Lec.* 294
- *obliquus Say.* 292
- *obtusatus Harris.* 284
- parallelus *Say.* 297
- *Paykulli Kby.* 290
- perplexus *Lec.* 293
- planipes *Lec.* 279
- pollutus *Lec.* 294
- punctifer *Payk.* 286
- punctiger *Lec.* 298
- relictus *Mars.* 294
- *repletus Lec.* 286
- Saunieri *Mars.* 296
- sedecimstriatus *Say.* 293
- sellatus *Lec.* 281
- semisculptus *Lec.* 289
- *Senevillei Mars.* 281
- servus *Erichs.* 291
- sexstriatus *Lec.* 283
- *sordidus Say.* 296
- *spretus Lec.* 290
- stygicus *Lec.* 285
- *subhæmisphericus Beauv.* 286
- subopacus *Lec.* 279
- subrotundus *Say.* 295
- thoracicus *Payk.* 286
- Ulkei *Horn.* 283
- venustus *Lec.* 295
- vernus *Say.* 295

HOLOLEPTA Payk. 273
- *æqualis Say.* 276
- cacti *Lec.* 275
- fossularis *Say.* 276
- *grandis Mars.* 274

HOLOLEPTA—Continued
- lucida *Lec.* 276
- *platysma Erichs.* 275
- populnea *Lec.* 276
- *princeps Lec.* 274
- quadridentata *Fab.* 275
- vicina *Lec.* 275
- Yucateca *Mars.* 273

Margarinotus Mars. 279

ONTHOPHILUS Leach. 302
- alternatus *Say.* 303
- Lecontei *Horn.* 302
- *nodatus Lec.* 303
- *pluricostatus Lec.* 303

PAROMALUS Erichs. 306
- æqualis *Say.* 307
- *affinis Lec.* 307
- bistriatus *Erichs.* 310
- conjunctus *Say.* 307
- consors *Lec.* 309
- *corticalis Lec.* 309
- estriatus *Lec.* 307
- geminatus *Lec.* 307
- gilensis *Lec.* 309
- lautus *Zimm.* 308
- mimeticus *Horn.* 308
- *nana Lec.* 308
- opuntiæ *Lec.* 308
- quatuordecimstriatus *Steph.* 308
- seminulum *Erichs.* 310
- tejonicus *Horn.* 309
- tenellus *Erichs.* 309

Phelister Mars. 294

Platysoma Leach. 296

PLEGADERUS Erichs. 347
- Barbelini *Mars.* 348
- consors *Horn.* 350
- *Erichsonii Lec.* 348
- fraternus *Horn.* 350
- nitidus *Horn.* 350
- *pusillus* ‡ *Lec.* 348
- Sayi *Mars.* 349
- transversus *Say.* 349

Psiloscelis Mars. 278

SAPRINUS Leach. 312
- acilinea *Mars.* 338
- æneicollis *Mars.* 3.6

SAPRINUS—Continued.
æneipunctatus *Horn*........ 344
æquipunctatus *Horn*........ 333
alienus *Lec*................ 321
assimilis *Payk*............. 329
barbipes Mars.............. 344
Behrensii *Horn*............ 315
bigemmeus *Lec*............ 341
bigener Lec................ 340
californicus Mann.......... 322
ciliatus *Lec*............... 333
cœrulescens *Lec*........... 338
communis Mars............ 314
conformis *Lec*............. 328
consimilis Walker.......... 322
convexiusculus *Mars*........ 330
Copei *Horn*............... 320
cubæcola *Mars*............ 327
deletus *Lec*............... 314
deserticola Mars........... 344
desertorum Mars........... 337
desertorum ‡ *Mars*......... 344
dimidiatipennis *Lec*........ 344
discoidalis *Lec*............ 313
distinguendus Mars......... 323
estriatus *Lec*.............. 342
extraneus *Knoch*........... 327
ferrugineus *Mars*.......... 340
fimbriatus *Lec*............. 337
Fitchii *Mars*.............. 342
Floridæ *Horn*............. 318
fraternus *Say*............. 341
gaudens *Lec*.............. 345
imperfectus *Lec*........... 322
impressus *Lec*............. 324
infaustus *Lec*............. 324
insertus *Lec*.............. 332
interceptus Lec............ 314
interstitialis *Lec*.......... 316
Jareti Mars............... 343
laridus *Lec*............... 332
latubris Lec............... 328
lubricus *Lec*.............. 336
lucidulus *Lec*............. 344
lugens *Erichs*............. 322
mancus *Say*.............. 341
minutus *Lec*.............. 330

SAPRINUS—Continued.
neglectus *Mars*............ 335
obductus Lec.............. 336
obscurus *Lec*.............. 318
olidus Lec................ 336
orbiculatus *Mars*.......... 337
oregonensis *Lec*........... 323
pæminosus *Lec*............ 319
palmatus Say............. 344
parumpunctatus *Lec*....... 329
patruelis *Lec*............. 343
pectoralis *Lec*............ 317
pensylvanicus *Payk*........ 328
piceus ‡ *Lec*.............. 324
placidus *Erichs*............ 328
planisternus *Mars*......... 315
plenus *Lec*................ 336
posthumus *Mars*........... 319
pratensis Lec.............. 336
rotundatus *Kug*........... 314
rotundifrons Mars.......... 336
rubriculus *Mars*........... 335
rugipennis *Mars*........... 316
scissus *Lec*................ 330
scrupularis *Lec*............ 331
sejunctus Lec.............. 323
seminitens *Lec*............ 340
serrulatus *Lec*............ 345
sphæroides *Lec*............ 340
spurcus Lec............... 323
sulcifrons *Mann*........... 245
vescus *Mars*.............. 329
vestitus *Lec*.............. 339
vinctus *Lec*............... 332
vitiosus *Lec*.............. 335
wacoensis *Horn*........... 331
TERETRIOSOMA Horn......... 347
chalybæum *Horn*.......... 347
TERETRIUS Erichs........... 346
americanus *Lec*........... 346
obliquulus *Lec*............ 346
picipes ‡ *Lec*............. 346
TRIBALISTER Horn........... 290
marginellus *Lec*........... 290
TRIBALUS Erichs............ 301
americanus *Lec*........... 301
californicus *Horn*......... 302

CONTRIBUTIONS FROM THE LABORATORY OF THE UNIVERSITY OF PENNSYLVANIA.

NO. I.

CORUNDUM,

ITS ALTERATIONS AND ASSOCIATED MINERALS.

(Read before the American Philosophical Society, September 19th, 1873.)

BY F. A. GENTH.

At the meeting of the American Philosophical Society of April 21st, 1871, I have exhibited and described several peculiar crystals of corundum, either wholly or partly altered into other mineral species. The chemical examination of these and many others, which I have since received, has given results and led to conclusions which, in connection with their paragenesis, are of not less interest to the chemist and mineralogist than to the geologist.

My information as to the occurrences of corundum in Europe and Asia is too limited to give a full outline of the same; I shall confine myself therefore, to those of *this* country and shall endeavor to give briefly the most striking geological features under which they have been observed.

The rocks of the Laurentian System contain but very little corundum, and only a few isolated crystals of white, red and blue colors have been found in the granular limestones belonging to this formation. It occurs, for example, associated with spinel, chondrodite, hornblende, graphite and numerous other minerals at Warwick and Amity, in the State of New York; at Newton, Vernon and Franklin in New Jersey.

The largest deposits of corundum known in the world, occur in the chromiferous serpentine or chrysolite formation, and in the rocks immediately adjoining the same. Numerous localities have been developed from Massachusetts to Alabama, and it will always be a very interesting question, by what agencies such enormous quantities of alumina could have been precipitated to form corundum, which, by its subsequent alteration has given rise to many of our most widely distributed minerals and rocks.

The most important corundum deposit in the Eastern States has been discovered by C. T. Jackson,[*] at Chester, Mass.; it was subsequently described by C. U. Shepard[†] and J. L. Smith.[‡]

It consists of crystalline corundum in a fine scaly chlorite, or of a peculiar mixture of granular and crystallized corundum with magnetite (which is generally titaniferous), intermixed with more or less of a chloritic mineral. The whole deposit traverses two mountains for about four miles, with an average thickness of four feet, and lies in a talcose slate and serpentine between gneiss and mica slate, in the centre of the

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[*] C. F. Jackson, Sill. Journ. [2] XXXIX, 88.

[†] C. U. Shepard—Sill. Journ. [2] XL, 112-123; XLII, 421; XLVI, 256.

[‡] J. L. Smith—Sill. Journ. [2] XLII, 83.

Green Mountains. The gneiss contains *no* corundum; the talcose rock, however, has grains of emery, corundum and magnetite disseminated through the whole mass; a vein of oligoclase (so-called indianite) many inches in thickness with small particles of corundum diffused through it, runs for many rods through the chloritic rock.

The corundum is generally in small brownish crystals, or very fine grains; the variety sapphire is sometimes met with in bi-pyramidal crystals; pinkish margarite, disapore and corundophilite frequently invest the corundum or emery, which is also associated with tourmaline, cyanite chloritoid, ilmenite, rutile, etc. With the oligoclase occurs a dark-green variety of biotite.

The views of Jackson, endorsed by Shepard, that the Chester (Mass.) emery was a distinct mineral species and that it had the composition of hercynite, $FeO, Al_2 O_3$, has already been refuted by J. L. Smith.

I will here mention a few other New England localities of corundum, although they may not belong to the chromiferous serpentine region.

J. H. Adams[*] observed it in small quantity and rarely in situ at Pelham, Mass., in flattened masses of a brownish-black mica (Biotite, Shepard[†]) containing nodules of corundophilite (Vermiculite, Shepard[†]) inclosing white and sapphire-blue corundum.

At Litchfield, Conn., it is found in balls of cyanite, constantly associated with talc and diaspore (Shepard[†]); and at Norwich, Conn., in small crystals of sapphire-blue color, completely surrounded by fibrolite (Shepard[†]).

In Pennsylvania corundum is found in many localities between the serpentine and the granitic and gneissoid rocks, commencing near the Blue Hill, in Upper Providence Township, and extending for about five miles to near Rockdale, Middletown Township, Delaware County; and again appearing near Unionville, in Newlin Township, Chester County.

At Mineral Hill and the Black Horse, near Media, Delaware County, occurs a feldspathic rock, consisting of a triclinic feldspar of a yellowish-white or white color and granular structure, and showing striation very distinctly on some of the cleavage planes. A great part of it is already changed into kaolinite. It appears to be free from quartz, but disseminated through the mass are crystals of corundum more or less altered into fibrolite and a micaceous mineral, probably damourite; many loose crystals of corundum are found in the soil.

At Unionville, Chester County, crystals of corundum have been frequently met with in the soil, and even large boulders are not of unusual occurrence; a little over one year ago, the bed from which these evidently came was discovered. At the time of my visit I could see a mass of almost solid corundum about thirty feet in length, from five to ten feet in thickness, with a depth of about fifteen feet. The corundum is of a granular structure, a brownish-grey color, and like the crystals which

[*] J. H. Adams—Sill. Journ. [2] XLIX, 272.

[†] C. U. Shepard—Sill. Journ. [3] IV, 179-180.

were found in the soil, shows a gradual change into several other minerals. The species which have been observed at this locality are diaspore, gibbsite (Seal[*]), damourite, margarite, soda-margarite, euphyllite, zoisite, tourmaline, chlorite, lesleyite and pattersonite.

About one mile from Unionville on the road to Kennett Square, corundum crystals are found imbedded in granular albite, together with euphyllite and tourmaline; it is also associated with black spinel, chlorite, talc, actinolite, etc.

Of the occurrence of corundum in Virginia, I have only one indication in the shape of a piece of a pebble from the neighborhood of Staunton, Augusta County, which principally consists, as shown by a qualitative analysis, of chloritoid with minute particles of corundum disseminated through it and a mass of damourite attached to, or passing in small seams through the chloritoid.

By far the most numerous localities of corundum, and many of them of great scientific interest, are found in North Carolina. The most Eastern occurrence which appear to belong to this formation, is on the lands of the Widow McChristian near Friendship, in Guilford County, and forms part of the great titaniferous iron ore belt of that State.

The corundum, of which only some surface specimens have been found, is a *true emery*, consisting of granular corundum, mechanically mixed with magnetic iron. It is associated with a chloritic mineral, generally changed into a white micaceous one by weathering, ilmenite and small quantities of chromite. Two samples gave me as follows:

Corundum........................	= 52.24	—	44.86
Magnetite........................	= 42.77	—	46.29
Silicates, etc.....................	= 4.99	—	8.85

The whole bed lies in granitic rocks and there is no sign of serpentine or chrysolite in the neighborhood; the presence of chromite, however, and of the chlorites, closely resembling those of the serpentine range, makes it probable that the belt belongs to the latter.

Science is much indebted to Rev. C. D. Smith, to whom the credit is due, for the discovery of the corundum belt which stretches with occasional interruptions in a southwesterly direction from Madison County, North Carolina, through Georgia into Tallapoosa County, Alabama, a distance of at least 250 miles. Of this, C. U. Shepard[†] gave, a short time ago, an elaborate description. The first large mass was found in 1847, on the French Broad River, three miles below Marshall in Madison (then Buncombe) County. It was of a dark-blue color and was associated with chlorite and margarite. The bed from which this and several smaller masses occurring in loose boulders have come, has never been found; but judging by the associated minerals there can be no doubt that it came from the great chrysolitic belt. I believe that I was the first

[*] T. F. Seal—Sill. Journ. [2] XI. 267.

[†] C. U. Shepard—Sill. Journ. [3] IV, 109 to 114 and 175 to 180.

to suggest, that the chromiferous and nickeliferous serpentines and talc slates owe their existence to the decomposition of chrysolite rocks ;[*] an opinion which has since been proved to be correct for those rocks wherever they have been found ; and lately by very careful examinations of serpentines and serpentine-like rocks made by Richard von Drasche.[†]

C. U. Shepard[‡] endeavors to show that the real composition of these rocks is not that of chrysolite but of villarsite. I have, therefore, requested Mr. Th. M. Chatard to analyze a specimen from the Culsagee Mine or Corundum Hill, near Franklin, Macon County, North Carolina, and for comparison, add my old analysis of a variety from Webster, Jackson County, North Carolina.

	Chatard.	Genth.
SiO_2	= 41.58	41.89
Al_2O_3	= 0.14	trace
FeO	= 7.49	7.39
NiO (tr Co & Mn)	= 0.34	0.35
MgO	= 49.28	49.13
CaO	= 0.11	0.06
Ignition	= 1.72	0.82
Chromic iron, etc	= —	0.58
	100.66	100.22

Villarsite is only an intermediate product of decomposition between chrysolite and serpentine. A rock, which approaches the latter mixed with a triclinic feldspar, occurs under similar circumstances as the Cullakenee or Buck Creek Mine in Clay County.

An analysis of a specimen which, however, was not quite pure, gave me:

SiO_2 (by difference)	= 35.19
Al_2O_3	= 0.64
FeO	= 9.70
MgO	= 40.99
Ignition	= 13.48
	100.00

The outcrop of the Culsagee Mine extends over thirty acres and the strata developed there are, according to Prof. Shepard (loc. cit.) :

"1. Chrysolite rock, somewhat mixed with anthophyllite ;

2. a layer of micaceous rock ;

3. a seam of chalcedony ;

4. a stratum of chloritic rock (ripidolite);

5. the same through which the corundum is irregularly diffused, sometimes in narrow veins or widening out to several feet."

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[*] F. A. Genth—Sill. Journ. [2] XXXIII, 202.

[†] R. von Drasche, in G. Tschermak's Mineralogische Mittheilungen 1871, 1.

[‡] C. U. Shepard--Sill. Journ. [3] IV, 112.

"Narrow veins containing, besides the chlorite and corundum, a dark-blackish-green spinel, more or less mingled with black tourmaline, traverse the layers 4 and 5 in various directions."

From Col. Jos. Willcox I have obtained some additional information. He states that the chlorite schist is much decomposed even to a depth of fifty or sixty feet, and the corundum in the same easily falls into fragments. The chlorite schist strikes northeast and southwest. At right angles to it a vein of chlorite several feet wide has been uncovered, which contains the large crystals of corundum, which also fall readily into fragments. A small vein of much decomposed albite, containing small crystals of corundum, passes through the chlorite. At the same place small crystals of corundum are occasionally found in black tourmaline. Associated with the minerals already named are actinolite, asbestus talc, etc.

From Prof. Shepard's paper and the private communications of Rev. C. D. Smith and Col. Jos. Willcox, I gather the following information with reference to the Cullakanee or Buck Creek and the Shooting Creek localities, both in Clay County.

About twenty miles southwest from the Culsagee Mine near Buck Creek, in Clay County, is the so-called Cullakenee Mine; the outcrop of the chrysolitic rock covering an area of about 300 acres. Corundum is here found in boulders in many places. The chrysolite contains the usual associates of the serpentine localities, such as actinolite, picrolite, etc., and is already partly changed into serpentine. Near the middle of this chrysolite bed is an outcrop of a very peculiar rock, resembling the omphacite of Hof, Bavaria, and consisting of green smaragdite,* a white triclinic feldspar and highly colored grains of ruby, sometimes also intermixed with small quantities of cyanite and chromite. The corundum at the Cullakenee Mine is generally of a grayish-white, or pale ash-gray color, rarely with specks of sapphire through it; sometimes also of a beautiful pink color, and is associated with andesite, zoisite, margarite, hornblende, and rarely with chlorite, spinel and tourmaline. A peculiar white or grayish-white scaly mineral in flattened masses with a nucleus of corundum rarely occurs, which is described under the name willcoxite.

About ten miles southwest of Cullakenee, near Shooting Creek, Clay County, corundum is again met with, and for five or six miles from this place extending into Towns County, Georgia, it is found at many places associated with chlorite, and probably smaragdite; the chrysolite lying between beds of hornblendic gneiss.

The Rabun County, Georgia, locality much resembles that of the Culsagee Mine near Franklin, North Carolina, and the corundum which I have seen from there can hardly be distinguished from the latter.

Near Gainesville, Hall County, Georgia, occurs a very peculiar variety of corundum. For the information about this locality and the specimens

* See below.

I am indebted to Rev. C. D. Smith. He states that soapstone appears to be the leading rock. Amongst the specimens were several which appeared to be talc slates of a pale greenish-white color, but, which by an analysis of Dr. Geo. A. Koenig, were proved to be a true chlorite slate. He found :

SiO_2	= 30.33
Al_2O_3	= 20.90
Fe_2O_3	= 4.00
FeO	= 4.11
MgO	= 27.79
Ignition	= 12.62
	99.75

The corundum occurs as a nucleus in irregular kidney-shaped masses of margarite, or with a peculiar earthy mineral of a color between isabel and flesh-red, and frequently intersected by veins of a fine scaly or massive margarite. I shall give the analyses of both in the mineralogical part of this paper. There are found at the same locality dark-green foliated chlorite, actinolite, asbestus and tourmaline.

It remains to say a few words with reference to the occurrence of corundum near Dudleyville, Alabama. For specimens from this locality I am indebted to Rev. C. D. Smith, of Franklin, North Carolina, and to Prof. Eugene A. Smith, of Tuscaloosa, Alabama. From these it is evident that the deposit is a repetition of those already discussed ; chrysolite rocks to a great extent changed into serpentine and even talc, with asbestus, chlorite and tourmaline ; the corundum is associated with spinel, margarite and dudleyite, a mineral resulting from the alteration of the latter.

Very similar to these occurrences of corundum in our great chromiferous serpentine region are those in the Ural, described by G. Rose.[*] At Mramorsk, on the west side of a marble quarry is one of leekgreen serpentine, and at another quarry a greenish-black chlorite schist with fine grained emery intermixed. The chlorite schist contains little veins or patches filled with a rose-red or reddish-brown mineral, foliated chlorite, a white micaceous mineral and yellowish-gray granular zoisite. Some of the veins contain diaspore and chloritoid. The marble quarry at Kassoibrod has on its western side chloritic schist ; on the eastern side granite. In the chlorite schist was found a crystal of blue corundum, a six-sided prism with basal plane on which was observed white star-like opalescence. Generally there is very little corundum present ; the associations of which are tourmaline, chlorite, etc.

J. L. Smith,[†] in his very important paper on emery, relates the occurrences of emery, corundum and associated minerals in Asia Minor and the Grecian Archipelago. According to his observations the emery is always imbedded in marble or granular limestone when found in situ; the marble lies upon mica slate, gneiss or granite. The minerals associated with the emery and corundum are: diaspore, gibbsite, zinc-spinel, pholerite, ephesite, margarite, mica (muscovite?) chloritoid, black tourmaline, chlorite, magnetite, hematite, limonite, rutile, ilmenite and titaniferous iron.

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[*] G. Rose Reise nach dem Ural, etc., 151, 248, 256.

[†] J. L. Smith--Sill. Journ. [2] X, 355 ff. and XI, 53 ff.

This represents very much the list of the species which occur with the corundum and emery of our chromiferous serpentine region and it is not improbable that the emery beds in Asia Minor and Greece are of analogous age.

I have now to speak of the occurrence of corundum or of minerals resulting from its alteration in a series of slates considered by E. Emmons* as belonging to his Taconic System.

The first corundum in them was discovered in 1852, by Dr. C. L. Hunter,† in Gaston County; it occurs at Crowder's Mountain and Clubb's Mountain; and it has lately been discovered under similar circumstances in Rutherford County. It is associated with rutile, cyanite, damourite, lazulite, pyrophyllite, gold and quartz.

There are reasons to believe that the pyrophyllite beds in Orange, Chatham, Moore and Montgomery Counties are analogous to the corundiferous strata of Gaston County; and the same appears to be true for those at Graves Mountain, Lincoln County, Georgia.

There are two occurrences of conundrum in cyanite in the gneissoic rocks at Swannanoa Gap, Buncombe County, and in Wilkes County, North Carolina; neither of which seem to have any connection with the serpentine belt.

I have yet to mention the occurrence of corundum in Laurens District, South Carolina, which is probably in mica slates. All the specimens which I have seen from this locality are rough bipyramidal crystals from one to three inches in length and from one-fourth to one inch in thickness. They are all more or less altered. Most of them are coated with a micaceous mineral into which many of the crystals are completely converted.

I shall not dwell upon the crystals of corundum, ruby and sapphire which are frequently met with in the heavy sands of gold washings as they occur in too minute quantities to have any bearing upon the principal questions which forms the subject of this investigation.

After thus giving a brief outline of the geological features of the occurrence of corundum, I shall now enter upon the consideration of the minerals which are fonnd in association with the same, but will first make a few remarks with reference to the chemical analyses which are embraced in this paper.

The greatest pains were taken to select the very best and purest material; and all the small fragments, before being reduced to powder, were repeatedly examined with a powerful magnifying glass, until the material for analysis was as clean as it was possible to obtain it. This plan was always strictly adhered to, except in a few cases where it was an impossibility to obtain perfectly pure material, but where an approximation was still desirable to identify the species.

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* Ebenezer Emmons, Geol. Report of the Midland Counties of North Carolina, 1856.

† C. L. Hunter—Sill. Journ. [2] XV, 373.

The finely powdered minerals were then dried under an exsiccator, over sulphuric acid. As very few of the species analyzed could be decomposed by acids, they had to be fused with sodic carbonate to render them soluble. For the alcalies, the mineral was in a few cases decomposed by fluohydric acid, generally, however, by J. L. Smith's very accurate and convenient method.

The mass of the sodium fusion was then *completely* disintegrated by water, and the whole dissolved in very dilute chlorhydric acid. If the decomposition of the silicates was *complete* and *no appreciable quantity of corundum was mechanically mixed with the mineral*, the solution in dilute acid was perfect, and rarely only a few flakes of silicic acid separated, which were easily distinguished from the heavy, hard, sandy corundum. Both (if both were present) were filtered, washed, dried, ignited and weighed; the silicic acid extracted by a dilute solution of potassic hydrate. After washing out with boiling water, to which towards the end of the washing, a few drops of chlorhydric acid was added, the corundum was weighed, then rendered soluble by fusion with potassic hydric sulphate, from the solution of which the pure alumina was precipitated as usual.

From the fusion for the alcali determination, the residue after extraction by boiling water was treated in a similar manner. The fusion with sodic carbonate acts more powerfully upon corundum, but unfortunately even the fusion of corundum with calcic carbonate and ammonic chloride, renders such a quantity of corundum soluble, that this method can not be used for a quantitative determination of the same.

The analyses were then conducted as usual, the alumina was separated together with ferric oxide by ammonic hydrate and boiling of the ammonical magma, until it had a neutral or even acid reaction. After filtering and washing they were re-dissolved and re-precipitated, and this operation generally repeated three or four times. The ferric oxide in the alumina was determined after the conversion of both into sulphates and its reduction by zinc, by titration with potassic permanganate.

The amount of ferrous oxide was *always* ascertained by dissolving the minerals in a sealed tube under pressure with dilute sulphuric acid, and subsequent determination with potassic permanganate.

Some apparently quite pure spinels left when treated in this manner a small quantity of a sandy powder, which proved to be corundum. I had hoped that by this method an accurate determination of corundum, mechanically mixed with other minerals, could be obtained, but I found that dilute sulphuric acid under such circumstances dissolves corundum, reduced to an impalpable powder, with tolerable ease. We have therefore no means to determine the quantity of corundum, which is *mechanically* mixed with another mineral. This is unfortunate, as it will leave us in doubt about the true constitution of some varieties of lesleyite and of ephesite.

Magnesia was always precipitated by ammoniac phosphate. Of the alcalies the potassic sodic and lithic chlorides were weighed together, then the potassium were separated and weighed as potassic platinochloride, and in the filtrate, after the removal of the excess of the platinum and the conversion of the alcalies into sulphates, the quantities of sodium and lithium were determined by indirect analysis. As however, in many cases the quantity of lithia, indicated by the spectroscope, was only small, very few such determinations have been made.

These being the more important points with reference to the modes of analysis, I shall now proceed with the description of the minerals.

1. Corundum.

As it would require unnecessary repetition, I shall not at present describe the numerous varities of corundum, but shall mention their peculiarities, when treating of the minerals associated with them, and of their relation to each other.

2. Spinel.

Corundum altered into spinel occurs at several localities.

a. The most interesting variety comes from Hindostan, and was found in a lot of corundum crystals, purchased by Messrs. S. S. White & Co., to whom I am indebted for specimens.

The surface of these crystals or crystalline masses is rough, and to many of them reddish orthoclase and a dark mica are attached, showing their matrix to have been granite. Some pieces of the corundum contain also small scales of reddish-white margarite. The crystals are too indistinct for measurement, but the basal plane and one or two pyramids can be observed. Many are completely altered, most of them, however, show that the alteration began at the surface and has irregularly penetrated the crystals towards the centre, often leaving a nucleus of brownish-gray cleavable corundum, or patches of the same irregularly distributed through the mass. Most of the crystals are from a half an inch to about two inches in size, rarely larger.

The spinel, which is the result of this alteration, has a black color, granular crystalline structure and a submetallic to vitreous lustre. Its powder is gray; it is slightly magnetic.—H.=8. Sp. Gr.=4.208.

b. In the shaft on the road from Unionville to Kennett Square, associated with granular grayish-white talc and greenish actinolite occurs intimately mixed with chlorite, a black granular mineral of vitreous lustre and a hardness superior to that of quartz. It was impossible to obtain it for analysis in a state of purity, but sufficiently so to prove it to be spinel.

c. The vein of spinel passing through the chlorite at the Culsagee Mine, North Carolina, has already been noticed above. The spinel is generally massive, coarsely to finely granular; also met with in octahedral crystals with dodecahedral planes; the latter often indicated only by striation. The crystals are often imperfect and cavernous, and mostly altered on the surface, being covered with a varnish-like coating of a brownish-gray mineral of vitreous lustre. The interior of the crystals like the fresh fracture of the unaltered massive spinel is black. The spinel contains, sometimes, grains of a reddish-brown rutile, and is always more or less intermixed with grains of corundum and chlorite, the latter frequently radiating from it. One specimen in the University collection is a mass of chlorite, radiating from nucleus consisting of a mixture of spinel and corundum.

d. Another variety of spinel from the same locality, of which, however, I found only a single specimen, resembles G. Rose's *chlorospinel* from Slatoust, and is found in deep leek-green or greenish-black octahedra with deeply striated dodecahedral planes or in granular masses of the same color; it is associated with a pale green foliated chlorite and white corundum. The spinel is often imbedded in the foliæ of the chlorite and not unfrequently contains particles of corundum in its centre. Its powder is pale grayish-green.

e. The collection of Col. Jos. Willcox contains a specimen from the same locality which evidently was once a corundum crystal. It measures about two and a-half inches in diameter and its outlines indicate its origin. It now consists of a nucleus of black spinel with a mantle of chlorite.

f. At the Cullakenee Mine spinel is of rare occurrence. I have seen only one piece in which a black variety in grains and octahedral crystals is disseminated through dark green foliated chlorite.

g. At Dudleyville, Tallapoosa County, Alabama, black spinel surrounding patches of yellowish-white cleavable corundum occurs in chlorite.

h. In connection with these observations it is worthy of notice that a variety of spinel, gahnite, in association with the corundum of Gumuch-Dagh in Asia Minor was discovered by J. L. Smith (loc. cit.).

The following analyses were made:

*a*1 and 2, from Hindostan, by myself.
b, from Unionville, by Dr. G. A. Koenig.
*c*1, fine-grained from Culsagee, by Dr. Koenig.
*c*2, coarser grained from Culsagee, by Dr. Koenig.
d, coarse-grained and crystallized dark-green from Culsagee, by myself

	*a*1	*a*2	Mean.	*b*	*c*1	*c*2		*d*
Sp. Gr.	= 4.208	——	——	——	3.766	3.797		3.695
Al_2O_3	48.87	48.10	48.49	54.61	60.03	62.38		68.08
Fe_2O_3	17.30	18.17	17.73	4.10	9.49	7.79		1.75
Cr_2O_3	——	——	——	——	3.23	1.81		trace.
FeO	23.53	23.25	23.39	10.67	9.33	11.89		11.02
MnO	trace.	trace.	——	——	——	——		trace.
MgO	6.86	6.66	6.76	13.83	16.74	14.98		19.29
SiO_2	——	——	——	1.26	1.14	1.56	CuO =	0.11
Corundum	=4.31	4.31	4.31	16.24	——	——	NiO —	0,24
	100.87	100.49	100.68	100.71	99.96	100.41		100.49

Neither specimen showed on examination with a magnifying glass any corundum, but both *b* and *c*1 and 2 contained small quantities of chlorite. I shall leave out the analysis *b*, which was made with material of not sufficient purity to base any calculation upon the results, but only for the purpose of ascertaining the character of the black mineral. This analysis, however, established the very important fact of the mechanical admixture of corundum. Taking into consideration the analyses of *a* and *c*1 and 2, and *d*, we arrive at the following data:

a. The oxygen in the mean results of the two analyses of the spinel from Hindostan is, in the sesquioxides, 4.22 per cent. in excess over that required by the formula RO, R_2O_3, showing that besides the 4.31 per cent. of corundum, which was not dissolved by dilute sulphuric acid, 9.05 per cent. had gone into solution, and that the most carefully selected material still contained a mechanical admixture of 13.36 per cent. of corundum. The composition of the pure spinel, together with that of the pure spinels from Culsagee, I shall give below.

*c*1. After deducting for 1.14 per cent. of SiO_2, 0.93 Al_2O_3, 0.09 Fe_2O_3, 0.22 FeO and 1.18 MgO, corresponding with the foliated chlorite from this locality, the oxygen ratio between RO and R_2O_3 required by the spinel formula is 6.67 per cent. in excess in the sesquioxides, representing an admixture of 14.74 per cent. of corundum.

*c*2. The 1.56 per cent. of SiO_2 require, for making the foliated chlorite associated with the spinel, 1.28 Al_2O_3 0.14 Fe_2O_3, 0.32 FeO and 1.61 MgO, which being deducted, leaves the oxygen ratio between RO and R_2O_3 = 7.92 : 31.34, being for the sesquioxides 7.58 per cent. more than that required by RO, R_2O_3; this corresponds with a mechanical admixture of 16.27 per cent. of corundum.

d. The decomposition by dilute sulphuric acid gave 0.73 per cent. of silica and a trace of corundum, which were deducted from the quantity taken for analysis. The oxygen ratio 1 : 3.15 is nearly that of spinel. The excess of 1.57 per cent. of oxygen would represent an admixture of 3.37 per cent. of corundum.

After deducting these mechanical admixtures, the composition of the pure minerals is represented by the following:

	Hindostan *a*.	Culsagee *c*1.	Culsagee *c*2.	Culsagee *d*
Al_2O_3 —	45.17	54.32	56.58	66.63
Cr_2O_3	——	3.96	2.28	trace.
Fe_2O_3	20.30	11.51	9.66	1.80
FeO	26.79	11.16	14.60	11.35
MgO	7.74	19.05	16.88	19.86
CuO	——	——	——	0.11
NiO	——	——	——	0.25

These analyses show that the spinel, pseudomorphous after corundum, from Hindostan, and the green spinel from Culsagee *d*, are mixtures of the spinel varieties *pleonaste* and *hercynite*, whilst the spinels from Culsagee *c* (1 and *b*) contain besides an admixture of the variety *picotite*.

The spinels from Unionville, Pennsylvania, and Dudleyville, Alabama, contain only traces of chromic oxide and are probably mixtures of pleonaste and hercynite.

3. DIASPORE.

Diaspore has been observed in many places as the result of the hydration of corundum, but I am not aware that ever a real pseudomorph has been met with.

J. L. Smith (loc. cit.) has made the very important observation that all the corundum, which he had examined, contained water in variable quantities from 0.68 to 3.74 per cent., but states that the more careful and repeated examination showed the absence of diaspore or any other hydrate of alumina. May it not be that the diaspore is so very minutely distributed through the corundum, that even the best microscopic, or other examination could not detect it, as I just have shown with regard to the admixture of corundum in spinel?—On page 58 he makes the following remark: "*Yet of all the specimens collected, none offer so* "*much interest as those of diaspore imbedded in the corundum; here we* "*see the two minerals, without being able, in many places to distinguish the* "*line of separation, so imperceptible is the gradation. After what has* "*been said in respect to corundum, it is not astonishing to see this con-*"*nection of alumina more or less hydrated, with a hydrate of alumina of* "*definite composition.*"

The diaspore from the different localities has been so fully described that I have but little to add.

With the exception of the locality of Chester, Mass., where it had been found in considerable quantity and of great beauty, diaspore is a rare mineral in this country. Most beautiful crystals of it were found at the Unionville, Pa. locality, by Dr. Isaac Lea,* who gave a description of them before the Academy of Natural Science.

J. C. Trautwine† first noticed this mineral in cavities of the massive corundum from the Culsagee Mine, North Carolina, where it occurs in very minute but beautiful acicular crystals of the usual forms. Only one or two specimens have thus far been discovered.

I have not been able to detect it at any other of the North Carolina, South Carolina, Georgia or Alabama corundum localities.

4. BEAUXITE.

This hydrate of alumina, generally mixed with a considerable quantity of ferric hydrate and a hydrous aluminous silicate, occurs in considerable quantities in the southern part of France; it incloses occasionally grains of corundum.

T. S. Hunt's‡ remarks about this interesting fact, are as follows: "By intense heat this substance (beauxite) *is converted into crystalline*

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*Proceedings of the Academy Natural Sciences, April 9, 1877.

†Journ. Franklin Institute, XCIV, 7,

‡T. S. Hunt, Sill. Journ. [2] xxxii. 288.

“*corundum resembling emery in its physical characters, but the presence of grains of corundum in the hydrated mineral seems to show that the transformation may take place at ordinary temperature.*” I do not know of a single instance, in which corundum could have been eliminated under such circumstances from the hydrate ; on the contrary, the presence of grains of corundum in the beauxite prove pretty conclusively, that the latter results from the hydration of corundum, and that the grains which have been found are remnants not yet converted. The same may be said of the inclosing argillaceous matter, that it is the result of the alteration of corundum.

5. GIBBSITE.

This very rare hydrate of alumina has been so far as I can discover, only twice noticed in contact with corundum, evidently resulting from its hydration, first at Gumuch Dagh, Asia Minor, by J. L. Smith (loc. cit.) who observed it as forming an external coating of a crystal of corundum, and also in the form of a hexagonal prism. The latter is very probably a pseudomorph of gibbsite after corundum. The second locality is at Unionville, Pa., where T. F. Seal* found it as a thin coating of small mamillary incrustations on the albite rock. (The other coatings on corundum crystals, of which he speaks, are evidently not gibbsite, but margarite, as I shall show in the sequel.)

6. QUARTZ.

Sillem† mentions that quartz occurs pseudomorphous after corundum. I have never observed this pseudomorph, and have not seen the original paper, I therefore merely mention the fact for the sake of completeness.

7. OPAL.

It is perhaps worthy of notice that I have observed the variety hyalite in connection with corundum and minerals resulting from its alteration. At the Culsagee Mine it is rarely found in beautiful colorless and white botryoidal incrustation upon foliated chlorite, and also upon corundum. From Dudleyville, Alabama, I have one specimen, on which it occurs as a brownish-white botryoidal incrustation upon blue cleavable corundum.

One of the pseudomorphous fibrolite crystals, from Mineral Hill, Delaware County, Pa., has a slight coating of an amorphous botryoidal vitreous mineral, which appears to be hyalite.

8. SMARAGDITE (?) (KOKSCHAROFFITE).

I have already mentioned the peculiar rock formed by Smaragdite (?), a feldspathic mineral, and grains of pink or even deep ruby corundum, and sometimes chromite disseminated through the mass, which occurs at the Cullakenee Mine.

The grains of smaragdite (?) are very indistinct in form, but frequently show an obtuse angle like that of an amphibole. The color is from

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*T. F. Seal. Sill. Journ. [2] xi. 267.

†Sillem, Leonhard & Bronn's Jahrbuch—1851, 385.

emerald to grass-green, and passing into grayish-green to greeni
H = 5.5. Sp. Gr. of the grass-green variety = 3.120.

B. B. it melts easily to a greenish glass, whilst the outer
colored yellow.

A sample of the grass-green mineral, selected with great ca
parently *free from feldspar*, was analyzed by Mr. Thos. M. Chat
found :

SiO_2	=	45.14	contains oxygen	24.07	
Al_2O_3	=	17.59	" "	8.20	=
Cr_2O_3	=	0.79	" "	0.25	
FeO	=	3.45	" "	0.77	
NiO	=	0.21	" "	0.04	
MgO	=	16.69	" "	6.68	
CaO	=	12.51	" "	3.57	=
Na_2O	=	2.25	" "	0.58	
K_2O	=	0.36	" "	0.06	
Ignition	=	1.34			
		100.33			

This gives very nearly the atomic ratio of RO* : R_2O_3
0.25 : 1 = 4 : 1 : 4, corresponding to the formula : 4R
R_2O_3, SiO_2.

It will be observed that this agrees exactly with the c
Kokscharoffite, and that it has no resemblence to arfv
which it has been placed by C. U. Shepard (loc. cit.) as ch
ite. At some corundum localities we find that other varie
bole are associated with corundum, or even penetrate in
the same.

A black or brownish-black hornblende frequently occu
site of Cullakenee, Clay County, North Carolina, and
almost black variety, resembling actinolite is found, o
with zoisite, with and in the corundum of the same local
the corundum at Shooting Creek in the same County, a
Culsagee Mine.

9. ZOISITE.

In the Ural, at Mramorsk, zoisite has been observed
cit.) as an associate of corundum. B. Silliman† describe
name *unionite* as occurring in company with corundum,
euphyllite at Unionville, Pennsylvania, but the best lo
Cullakenee Mine, in Clay County, North Carolina. H
crystals, but usually in compact columnar and easily
Its color is from grayish to greenish and brownish-whi
specimens show distinctly that it is the result of the alt
dum. The pink corundum is often surrounded by a

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*Including R_2O in this and all subsequent analyses.

† B. Silliman 2] VIII, 384.

white zoisite. The University collection contains some remarkable specimens.

One forms a narrow vein of cleavable pink corundum in grayish-green hornblende. Between the corundum and the hornblende is a thin lining of zoisite, which becomes thicker and thicker and soon occupies the whole vein, first in compact, then in cleavable columnar masses, the corundum having entirely disappeared. Another piece of blueish-gray corundum is on one side altered into columnar brownish-white and white zoisite, whilst the interior is to a great extent changed into margarite. Many of the other pieces show nuclei of unaltered corundum disseminated through the mass of zoisite.

The following were analyzed:

a, slightly greenish-white cleavable zoisite, the result of the alteration of pink corundum, by Dr. Koenig.

b, white, slightly grayish columnar zoisite, resulting from blueish-gray corundum, nuclei of which were still visible, by myself.

c, for comparison I give the analysis of the zoisite from Unionville, by G. J. Brush* (Silliman's Unionite).

		a.	*b*1.	*b*2.	*c.*
Sp. Gr.	=	3.286		3.224	3.299
SiO_2	=	40.70	39.43	39.86	40.61
Al_2O_3	=	33.86	34.92	33.84	33.44
Fe_2O_3	=	0.81		1.62	0.49
MnO	=	trace.		trace.	——
MgO	=	0.22		0.18	trace.
CaO	=	24.05		23.82	24.13
Na_2O (trace Li_2O)	=	not det'd		0.22	——
K_2O		.. ..		0.09	——
Ignition	=	0.63		0.78	2.22
		100.27		100.41	100.89

The oxygen ratio of RO : R_2O_3 : SiO_2 are as follows:

a = 6.96 : 16.02 : 21.71 = 1 : 2.30 : 3.12
b = 6.94 : 16.25 : 21.26 = 1 : 2.34 : 3.06
c = 6.89 : 15.74 : 21.66 = 1 : 2.28 : 3.14

All these analyses of the zoisite associated with corundum show a slight excess of alumina, if we take the ratio of 1 : 2 : 3 as representing the composition of zoisite. If this is owing to a small admixture of unaltered corundum, the three specimens analyzed would contain: *a* 4.50 per cent., *b* 5.0 per cent., and *c* 4.21 per cent. of it.

10. FELDSPARS.

Many varieties of feldspar occur with corundum under circumstances which are of the greatest scientific interest.

a. A white, grayish and reddish variety of *anorthite* called *indianite* by Count Bournon, is the matrix of corundum in the Carnatic. Associated minerals are cyanite and garnet. It has been analyzed already by Chenevix more than 70 years ago, and lately again by G. J. Brush* with almost identical results, if we except the small quantity of soda which the former had overlooked. Oxygen ratio of RO† : Al_2O_3 : SiO_2 = 1 : 3 : 4.

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* G. J. Brush, Sill. Jour. [2] XXVI, 69.

b. A snow-white massive granular feldspar also occurs as the matrix of corundum at Barsowskoi, near Kyschtimsk in the Ural, where G. Rose discovered it, who finding it different in composition gave it the name of *barsowite.* Oxygen ratio of CaO : Al_2O_3 : SiO_2 = 1 : 3 : 5. I have seen only one specimen in which the grayish corundum in dipyramidal crystals was disseminated through the feldspathic mineral. In fracturing a piece the corundum crystals left a smooth impression upon the barsowite, as if they were already hard when the latter was still in a plastic condition.

c. A snow-white or blueish-white cleavable variety of feldspar showing a fine striation upon the cleavage planes, is found associated with a greenish-black hornblende with a distinct cleavage angle of 124°, is found at the Cullakenee corundum locality, but I have not been able to detect corundum in any of the *cleavable* specimens, which I had for examination. See analysis below. (a).

A granular and very compact variety with crystals of corundum disseminated through it, is found at the same locality. In a fresh fracture the corundum is hardly distinguishable, except by its somewhat grayer color. In weathered specimens the corundum crystals, some of nearly one inch in diameter, stand out in bold relief. They are very rough, as if they were eaten, and in many of them a micaceous mineral, damourite probably, is associated with them, which not only coats the outside but penetrates even to the centre of the crystals. I received this variety too late for chemical analysis.

Together with massive gray corundum, partly altered into zoisite, is rarely found at the same locality a white granular variety of feldspar, much of the appearance of sugar, but pretty tough. It seems to have been the result of the alteration of corundum. The analysis is given below (b).

d. Another fine-grained and very friable variety from Cullakenee has much of the appearance of the oligoclase (indianite) of Chester, Massachusetts. It is distinguished from the Chester mineral by a dissemination through the whole mass of fine grains or crystals of hornblende, whilst the latter contains biotite in their place. It has not been analyzed.

I have already mentioned the triclinic feldspar, forming with smaragdite and red corundum, the peculiar rock which so nearly resembles that from Hof in Bavaria. I have not been able to obtain it in a state of sufficient purity for analysis.

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* Dana's Descriptive Mineralogy. 1868, 339.

† RO = 1·6 Na_2O + 5·6 CaO.

From this locality I have the analyses of the cleavable snow-white variety (*a*) by Dr. Koenig; and of the fine-grained, like sugar, probably resulting from the alteration of corundum, by Mr. Thos. M. Chatard (*b*) They found:

		a.			*b.*		
Sp. Gr.	=	2.611	oxygen		2.610	oxygen	
SiO_2	=	57.29	30.55		58.41	31.15	
Al_2O_3	=	26.52	12.36	12.42	25.93	12.08	12.19
Fe_2O_3	=	0.21	0.06		0.38	0.11	
MgO	=	0.15	0.06	4.09	0.18	0.07	3.74
CaO	=	7.80	2.23		5.82	1.66	
Na_2O	=	6.75	1.74		6.45	1.66	
K_2O	=	0.33	0.06		2.10	0.35	
Ignition	=	1.43			0.93		
		100.48			100.20		

The oxygen ratios in the two analyses are as follows:

$RO : R_2O_3 : SiO_2$ in *a* = 4.09 : 12.42 : 30.55 = 0.99 : 3 : 7.51
in *b* = 3.74 : 12.19 : 31.15 = 0.93 : 3 : 7.67

which is near the atomic ratio of 1 : 1 : 4, agreeing with the formula of andesite = $(Na_2O, CaO) SiO_2 + Al_2O_3, 3SiO_2$.

c. The soda-oligoclase, which, associated with euphyllite, accompanies corundum at Unionville, Pennsylvania, has been analyzed by Smith and Brush[*].

A specimen in the University collection from the same locality consists of a granular yellowish or brownish-white oligoclase, the small cleavage planes of which are sometimes finely striated. It has patches of a granular gray corundum disseminated through the mass, mixed with minute grains of a hard greenish-black mineral, probably spinel. The corundum in some places altered into a soft crypto-crystalline slightly pearly, white or grayish-white mineral, which appears to be margarite; it is frequently penetrated by the oligoclase and looks as if it was a remnant from its conversion into oligoclase and other species. The analysis of it by Mr. Chatard gave:

SiO_2	=	59.35	contains oxygen	31.65	
Al_2O_3	=	24.16		11.26	= 11.44
Fe_2O_3	=	0.61		0.18	
MgO	=	0.34		0.14	= 3.52
CaO	=	3.08		0.88	
Na_2O	=	7.22		1.86	
K_2O	=	3.78		0.64	
Ignition	=	1.96			
		100.50			

The oxygen ratio of $RO : R_2O_3 : SiO_2$ = 3.52 : 11.44 : 31.65

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[*] Sill. Journ. [2] XV, 211 and XVI, 44.

which is = 0.92 : 3 : 8.30, or very near 1 : 3 : 9 in accordance with the formula of oligoclase = $2\ (K_2O, Na_2O, CaO), 3\ SiO_2 + 2\ (Al_2O_3, 3\ SiO_2)$.

f. The yellowish-white granular feldspar of Mineral Hill, Delaware County, Pennsylvania, above referred to, which contains crystals of corundum altered into fibrolite and other minerals, seems also to be oligoclase.

g. The so-called indianite from Chester, Massachusetts, has been proved by C. T. Jackson's* analysis to be granular oligoclase.

h. The white granular feldspar from the locality on the road from Unionville to Kennett Square has been analyzed by Brush and Weld,† who found it to be albite, containing a small percentage of lime. It is frequently the matrix of gray corundum associated with euphyllite (?). The corundum crystals are rough and irregular and are always more or less coated, enveloped or changed into euphyllite, and also a soft, apparently amorphous, mineral, which is probably a variety of margarite, of which, however, I had not enough for an analysis.

The very interesting question presents itself: are the feldspars found in connection with the corundum, the result of the alteration of the latter? I am not prepared to give a positive answer, and believe that it requires a great many more observations before it can be decided. From what I have seen, it appears that there are cases where feldspars have been formed from corundum, and it is very probable that many have thus been formed, but that at the same time a portion of the alumina re-crystallized as corundum, which we then find imbedded in the feldspathic matrix.

Very similar occurrences must have taken place in several other instances, to which I will here refer, viz.; the crystals of corundum in a matrix of tourmaline and the beautiful, very well defined crystals of it in the chlorite of the Culsagee Mine.

11. TOURMALINE.

Tourmaline has been found in association with corundum at most of the localities already referred to; for example, at Kassoibrod in the Ural, at Naxos in Greece, at Chester, Massachusetts, at Unionville, Pennsylvania, at the Culsagee Mine, rarely at the Cullakenee Mine, and more frequently at Dudleyville, Alabama.

a. At Unionville black tourmaline is frequently found in irregular masses of different sizes, from a small grain to several inches in diameter, in the corundum as well as in the minerals resulting from its alteration, especially in the foliated margarite or with zoisite and euphyllite. It sometimes shows crystalline prismatic planes, but is mostly granular and occupies the interstices between the corundum itself.

A far more interesting occurrence is mentioned by Dr. Isaac Lea (loc.

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* C. T. Jackson's, Sill. Journ. [2] XLII, 107.

† Brush and Weld, Sill. Journ. [2] VIII, 390.

cit.) of a crystal of transparent green tourmaline passing through the middle of a prism of diaspore, and the whole enveloped by lamellar crystals of pearly emerylite (damourite, Gth.). Very similar is the occurrence of slender green crystals in the pseudo-fibrous damourite. These tourmalines are in all probability the result of the alteration of corundum. or, the black tourmaline went into solution and re-crystallized in the diaspore and damourite in a similar manner, as apophyllite dissolved in water in a sealed tube under pressure, crystallizes out on cooling, as shown by Wöhler in his well known and important experiment.

b. The association of corundum with tourmaline at the Culsagee Mine deserves the greatest attention.

There are masses of black tourmaline, which contain more or less frequently, and irregularly disseminated through them, crystals of white and yellowish-white corundum; plates of chlorite are also, sometimes, penetrating the tourmaline. The corundum crystals have particles of tourmaline intermixed with them, and *vice versa*. *On the whole*, however, the tourmaline looks more like the *matrix* of the corundum. Sometimes there seems to be an almost imperceptible change of granular corundum into tourmaline. Of the numerous specimens which I have examined, two deserve a fuller description. The first is a small piece of black columnar tourmaline, with a micaceous mineral, probably margarite, and grayish-white corundum. In one case the upper part of the columnar mass of tourmaline is occupied by corundum, which also penetrates into a portion of the tourmaline; the tourmaline frequently contains nuclei of corundum. The second specimen, also from the same mine, for which I am indebted to the kindness of Col. C. W. Jenks, is a pseudomorph of tourmaline after corundum. It is part of a crystal of reddish-gray corundum of a little over two inches in height and about two inches in thickness. It shows three planes of the hexagonal prism and portions of one pyramidal plane. At the upper part of this crystal, almost the entire corundum has been altered into black tourmaline, leaving only a shell of corundum of about one-eighth to one-quarter inch; at its lower part the corundum, although intermixed with tourmaline, is still about one inch in thickness. Plates of green chlorite penetrate both the corundum and the tourmaline.

c. At the Cullakenee Mine tourmaline occurs but sparingly. It is associated with foliated pink margarite and another mineral in slender prismatic, longitudinally striated crystals, resembling some varieties of epidote, but in too small quantity for mineralogical determination.

d. The occurrence of tourmaline at Bell's Creek, Town's County, Georgia, and Dudleyville, Tallapoosa County, Alabama, presents nothing remarkable.

12. FIBROLITE.

For a long time fibrolite has been known to accompany the corundum in the Carnatic, in India, and in the neighborhood of Canton, in China; the variety much used by the Celts in the *stone age* has been obtained amongst other localities from the vicinity of Chavagnac and Ourouze, in France, where it is associated with *mica, cyanite, red* and *blue corundum*. One of the most interesting localities is at the Falls of the Yantic, near Norwich,* Connecticut, where the *small crystals* of sapphire are completely surrounded by fibrolite. This is evidently owing to an alteration of corundum into fibrolite.

At Mineral Hill, Delaware County, Pennsylvania, as I have already mentioned above, corundum, more or less completely altered into fibrolite, occurs in a feldspathic rock. The corundum crystals are generally rough, six-sided prisms, tapering at both ends, from one-half to one and a-half inches in length and from one-eighth to one inch in thickness. They are of various shades between white and brown, often of a rich glove-brown color, many exhibiting a white or colorless star of six rays. This star when magnified shows already a fibrous structure. Where the alteration of corundum has just commenced, a thin coating of a grayish-white color, sometimes not thicker than a varnish, can be observed on the brown corundum. Under a strong glass it is seen to consist of a vitreous mineral, which is fibrous and radiating from the corundum. Many of the crystals have still a core of unaltered corundum, in others every trace of it has disappeared, and fibrolite pseudomorphous after corundum is left, the interior of which is made up of congeries of acicular crystals.

Only with great difficulty I was able to select a sufficient quantity of pure material for analyses.

The following are the results :

Spec. Grav. = 3.286.

		a.	b.	c.	Oxygen.	
		Almost Pure.		Purest.		
SiO_2	=	37.76	37.62	37.37	19.93	
Al_2O_3	=	60.27	60.91	60.52†	28.20	28.47
Fe_2O_3	=	0.98	0.94	0.90	0.27	
MnO	=	0.10	0.24	0.10		
MgO	=	0.18		0.25		
CaO	=	0.44	0.40	0.38		
Ignition	=	0.73	0.62	0.48		
		100.46	100.73	100.00		

The oxygen ratio of $R_2O_3 : SiO_2 = 1.43 : 1 = 3 : 2$, agreeing with the formula Al_2O_3, SiO_2.

At several localities in the immediate neighborhood and frequently within the serpentine region, in the State of Delaware, and Delaware County, Pennsylvania, fibrolite is found, which partly at least seems to have been derived from the alteration of corundum. I wish to call particular attention to that which occurs between Media, Delaware County, Pennsylvania, and the Asylum for Feeble-Minded Persons. On a fresh fracture, the silky lustre of its fibres can be easily perceived, but it has a slaty structure and is associated with white and pale blueish crystals of cyanite and brown staurolite crystals, many of them in twins. The whole reminds one immediately of the well known staurolite and cyanite crystals in the paragonite slate of St. Gothard.

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* C. U. Shepard, Sill. Journ. [3] IV, 180.

† By difference.

A similar fibrolite slate is found near the Culsagee Mine, Macon County, North Carolina.

Amongst fifty crystals of corundum from Laurens District, South Carolina, part of which are converted into damourite, I found one broken crystal, the outside of which is changed into fibrolite. It is an irregular six-sided prism, ⅝ of an inch long, not quite half an inch thick, with a core of unaltered brownish corundum ¼ of an inch in diameter. The fibrolite is radiating from the surface towards the core, and the surface is covered with crystalline aggregates of fibrous fibrolite and a few small plates of damourite.

For a highly interesting specimen, I am indebted to John C. Trautwine, Esq. He found it many years ago at Germantown, Pennsylvania. It consists of granular quartz with streaks of grayish-white fibrous fibrolite through it from ¼ to ⅜ of an inch in width, but less than a line in thickness. The centre of several of these streaks is occupied by blue bladed cyanite. It is impossible to decide, whether this is a case of paramorphism, in which the monoclinic changes into the triclinic silicate of alumina, Al_2O_3, SiO_2, or whether both crystallized from the same medium in their present form.

13. CYANITE.

Cyanite is a very usual associate of corundum. It is found with it on the St. Gothard, near Petschau in Bohemia, and in several other foreign localities. It is one of the most important results of its alteration. I have dwelled at fuller length upon the change of corundum into fibrolite, because there we have *real pseudomorphs* which appear not to exist with, chemically, the same aluminous silicate, the bladed structure of the cyanite immediately obliterating, probably, every trace of the original form. However, I shall describe a number of specimens of cyanite, containing still a nucleus of the original mineral, from which they resulted.

a. At Litchfield and Washington, Connecticut, rolled masses of cyanite have been found, which contained corundum and diaspore. I am indebted to Prof. Geo. J. Brush, for a very beautiful and instructive specimen from Newton, Connecticut. It consists of irregularly arranged bladed masses of gray and blueish-white and blue color. In some places, and especially, where the blades meet, a white or yellowish-white micaceous mineral is intermixed; imbedded in it sometimes is diaspore, and in one place in immediate contact with the cyanite, is a rounded fragment of a slightly pink colored corundum.

b. Another superb specimen was presented to me by Col. Jos. Willcox, who collected it a short time ago at Swannanoa Gap, Buncombe County, North Carolina. It consists of a fragment of an irregular hexagonal prism of corundum of about two inches in length and one inch in thickness, of a deep blue and white color, and showing the perfect rhombohedral cleavage; it is surrounded by pale blueish-white cyanite and damourite. The surface of the corundum appears much eaten and the specimen is a beautiful illustration of the alteration of corundum into the two other minerals.

c. A third specimen I received about two years ago from Mr. Hanna, Assistant Assayer of the Mint in Charlotte, North Carolina. It comes from Wilkes County, North Carolina. At that time I had no idea of the importance, in a scientific point of view, of some insignificant particles of corundum in cyanite, and procured the specimens only on account of the beauty of the latter. Mr. Hanna had another piece, which, if my memory serves me right, contains a mass of corundum of about one inch in diameter. The cyanite has an impure blueish-greenish color and coarsely bladed columlar crystals and crystalline masses, some of the blades 1 to 1½ inches across. Several small fragments and grains of corundum, of a gray to a reddish-brown color are visible in the mass of cyanite, one of them showing the usual striation very distinctly. A minute quantity of damourite is also present.

I shall now enter into the discussion of some points with reference to the occurrence of corundum in Gaston and Rutherford Counties, North Carolina, which form a close connection with the remarks just made, although I may be compelled to anticipate some facts, which should not yet be discussed.

At Crowder's Mountain, and Clubb's Mountain, in Gaston County, and at a recently discovered locality in Rutherford County, North Carolina, corundum is found massive and in crystalline pieces, sometimes showing a hexagonal form; its color is from deep blue to purple, and grayish-blue intermixed with white. The unaltered corundum is somewhat ferruginous and invariably contains crystals of rutile of different sizes disseminated through the whole mass. This corundum, however, is sometimes altered into a compact margarite, which coats the blue crystals, but generally into damourite and cyanite, which are associated with gold, granular quartz, etc. This alteration, however, goes frequently farther and leaves not a trace of corundum, and often nothing but scoriaeceous masses, the cavities frequently still containing small crystals of cyanite coated with a brownish-black limonite, and rutile in brilliant crystals or coated in the same manner. But there are two new products of the alteration associated with these, pyrophyllite and lazulite. The same association of cyanite, rutile, pyrophyllite and lazulite in an arenaceous sandrock is found at Graves Mountain, Lincoln County, Georgia, and although as far as I am aware, corundum has never been found at this place, there can be very little doubt that at this locality also all these species except rutile and quartz owe their existence to the former presence and subsequent alterations of corundum.

The same is in all probability true with reference to the occurrences of pyrophyllite, both radiated, stellate, and the slaty in Montgomery, Randolph, Moore, Chatham, and Orange Counties of North Carolina, and perhaps Chesterfield District, South Carolina.

14. STAUROLITE.

With the damourite, resulting from the alteration of corundum at the Culsagee Mine, are found very few and minute brown grains of subvitreous lustre; the grains are massive and of irregular shape and do not show a trace of a crystalline form. Their spec. grav. was found to be = 3.711, and the analysis showed them to be staurolite. It gave:

SiO_2	=	27.91	contains oxygen	–	14.49	
Al_2O_3	=	52.92	"	"	24.74	26.80
Fe_2O_3	=	6.87	"	"	2.06	
FeO	=	7.80	"	"	1.73	3.04
MgO	=	3.28	"	"	1.31	
CaO and MnO	=	traces				
Ignition	=	1.59				
		100.37				

The oxygen ratio 3.04 : 26.80 : 14.49 is = 1 : 8.8 : 4.8 or near 1 : 9 : 5 giving the formula $2RO, SiO_2 + 2 (3Al_2O_3, 2SiO_2)$.

15. PYROPHYLLITE.

In his "Chemical and mineralogical relations of the metamorphic rocks," T. S. Hunt* says: "*The last term in this exhaustive process appears to be represented by the disthene (cyanite) and pyrophyllite rocks, which occur in some regions of crystalline rocks.*"

I suggested under the heading "*cyanite*" that the pyrophyllite found in several of the Counties of North Carolina, South Carolina and Georgia, is the result of the alteration of the former, perhaps, from Al_2O_3, SiO_2 into Al_2O_3, $3 SiO_2 + H_2O$.

This view is sustained by pseudomorphs of pyrophyllite in the form of cyanite from Villa Rica, in Brazil, described by F. Sandberger.†

An association very similar to that at Crowder's Mountain, North Carolina and elsewhere, viz.: cyanite, pyrophyllite, damourite, hematite, and lazulite, occurs at Horrsjöberg, in the District of Elfsdalen, in rutile Wermland and Westana in Sweden. That these were formed under similar circumstances cannot be doubted.

Several other hydrous aluminous minerals have been found in association with corundum or with minerals which are the product of its alteration; for example, those accompanying the beauxite in the southern part of France, the dillnite with the diaspore of Schemnitz, and others, of which the species has not been sufficiently identified; they are mostly amorphous and their relation to the corundum is not striking enough to dwell more fully upon them. I turn my attention now to

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*T. S. Hunt, Sill, Journ. [2] XXXVI, 222.

†F. Sandberger, Leonhard—Broon's Jahrbuch der Mineralogie, 1855, 315.

16. DAMOURITE.

This species has been established on a mica-like mineral, an aggregate of fine scales, forming the gangue of cyanite at Pontivy, Brittany. It will be seen in the sequel that it is one of the most important products of alteration of corundum, from which it is either *directly* formed, or *indirectly*, after the corundum has first been changed into cyanite or fibrolite, which latter are subsequently converted into damourite. There is hardly a species, which assumes so many different shapes as this, and it is often impossible to determine it without analysis. S. P. Sharpless* was the first to prove that mica-like crystals, which accompany the diaspore from near Unionville, Newlin Township, Chester County, Pennsylvania, which always had been mistaken for margarite (emerylite) were damourite.

At Unionville, damourite is found in the following forms:

a. In crystals frequently having the lateral and sometimes the basal planes well developed; they appear to be hexagonal plates, but are probably rhombic. They are sometimes radiating and fan-shaped, and the crystalline plates from one to three inches in diameter. Their color is generally white to greenish-yellowish and brownish-white, but when treated with chlorhydric acid, which removes a little ferric hydrate which colors them, they are white with a very delicate shade of sea-green-rarely as deep as grass-green. Their lustre is pearly, sometimes inclining to vitreous.

These crystals or crystalline plates of larger or smaller size are directly attached to the granular grayish or brownish-white corundum or in the mass of the same; occasionally there is between them and the corundum a small seam of a crystallized dark-green chloritic mineral. Black tourmaline is another not uncommon associate, and especially, where the rare mineral diaspore appears, slender crystals of dark blueish, or brownish, green tourmaline are met with. This is the variety analyzed by S. P. Sharpless and Dr. G. A. Koenig (*a*).

b. Another variety of damourite consists of an aggregation of grayish and yellowish-white scales of one-sixteenth to not over one-quarter inches in diameter. After cleaning them with dilute chlorhydric acid they are silver-gray. They form a coating upon and sometimes occupy the whole of former corundum crystals and their aggregations are real pseudomorphs after corundum, generally with a core of original mineral. Dr. Isaac Lea has a fragment of a beautiful crystal of blue corundum over three inches in length and about two and a-half inches in diameter, which is coated with a coust of scaly damourite from one-eighth to one fourth inch in thickness. He very kindly furnished me with some for analysis (see below *b*1). He has presented me with a fine crystal of gray corundum, about two-thirds of which is changed into damourite. Col. Jos. Willcox, in his rich collection of American corundums, has several good crystals, of which he very generously contributed the material for analysis (see below, *b*2).

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* S. P. Sharpless, Sill. Journ. [2] XLVII, 319.

c. Another very beautiful variety of the same mineral forms also pseudomorphous crystals after corundum. The material for analysis was from a fragment of a crystal, showing on two sides the remnant of a pyramid. It contains a nucleus of gray corundum from which a very fine scaly white pearly damourite is radiating, giving it a pseudo-fibrous structure (*c*).

d. The scales of damourite occasionally become so fine that they cannot be distinguished with the naked eye and the mineral becomes massive, sometimes globular, sometimes with a slaty structure, similar to talc slate. This is often mixed with aggregation of larger scales of a greenish-white color and pearly lustre. Dr. Koenig has made an analysis of the massive globular greenish-white crypto-crystalline variety (see below, *d*).

e. A white or grayish-white variety of a fine scaly, often crypto-crystalline, structure, sometimes slaty, generally pseudo-fibrous, the apparent fibres from one-half to over six inches in length, frequently invests the granular grayish-white corundum. The lustre is generally very feeble, otherwise pearly, inclining to silky. Scales of damourite of a white or greenish color are disseminated through the white fibrous mass, sometimes in small veins or accumulating into masses to a scaly granular rock. An analysis of the pseudo-fibrous white damourite by Dr. Koenig is given below (*e*).

On one side and as a rule furthest from the corundum, it gradually becomes dull-green and changes into pure granular chlorite.

f. Next to the corundum is generally another variety of damourite, forming a seam between it and the white (*e*); it is from one-fourth to two inches in thickness.

Whilst crypto-crystalline and consisting of exceedingly minute scales, they are arranged in fibres at right angles to the corundum. This variety of damourite much resembles some kinds of serpentine. It has a yellowish oil-green color, its lustre is waxy or dull. It is remarkable that the slender crystals of tourmaline, which are frequent in the white variety (*e*) and which penetrate into the chlorite, have not been observed in any of the numerous specimens which I had for examination.

I shall give below my analysis of a sample, investing a mass of gray corundum (*f*1), and the mean of two analyses by Mr. Th. M. Chatard (*f*2), of a sample taken between the corundum and the white variety (*e*).

g. The highly interesting pseudomorphs of damourite after corundum from Laurens District, South Carolina, probably occur in mica slate. I have already stated that most of the crystals of corundum from this locality are coated with a micaceous mineral, which the analysis proved to be damourite. The pseudo morphous crystals show the shape of the corundum but are flattened as if by exposure to a heavy pressure. Many still contain a nucleus of unaltered corundum, others are entirely changed. They are aggregates of small yellowish-white scales. The material, which I have analyzed, was first purified by dilute chlorhydric acid and then presented the appearance of silver-white scales (*g*).

h. Very similar is the damourite which forms a bed of *mica schist* at the Culsagee Mine. The scales are somewhat larger than those from South Carolina, and the corundum crystals which still exist in it, not quite as deeply altered. They are associated with small grains of massive staurolite and some other black minerals, probably menaccanite, etc. An analysis of the scales purified by chlorhydric acid was made by Dr. Koenig, the results of which is given below (*h*).

i. The damourite, investing the crystals and masses of blue corundum at Crowder's Mountain and resulting from its alteration, occurs in scales, which are generally coated with ferric hydrate. A sample purified by chlorhydric acid was analyzed by Mr. Thos. M. Chatard (see below, *i*).

The results of the analyses of the various varieties of damourite, are as follows :

		a.	*b1.*	*b2.*	*c.*	*d.*	*e.*
Spec. Gr.	=	2.851	——	2.843	——	2.857	2.832
SiO_2	=	43.03	45.49	45.57	45.86	45.73	45.73
Al_2O_3		39.06		34.83	37.65	37.10	36.30
Fe_2O_3		1.48	2.34	2.94	0.59	1.30	0.83
MgO		0.30	——	0.83	0.55	0.34	0.54
CaO		trace.	——	0.40	0.31	trace.	0.74
Li_2O		trace.	——	trace.	trace.	trace.	trace.
Na_2O		0.58	0.32	0.87	0.80	0.88	0.58
K_2O		10.05	9.88	10.16	10.40	10.50	10.49
Ignition		5.40	3.89	5.30	4.74	4.48	5.17
		99.90		100.90	100.90	100.33	100.38

		f1..	*f2.*	*g.*	*h.*	*i.*
Spec. Gr.	=	2.779	2.760	——	2.867	2.860
SiO_2		46.98	46.60	45.71	45.63	43.51*
Al_2O_3		35.13	32.39	34.12	35.93	37.85
Fe_2O_3		0.61	2.54	3.45	2.93	
MgO		1.32	2.01	0.71	0.34	0.31
CaO		0.13	trace.	0.48	trace.	0.42
Li_2O		trace.	trace.	trace.	trace.	trace.
Na_2O		0.76	0.54	0.49	0.71	1.04
K_2O		10.74	10.39	10.36	9.40	11.35
Ignition		4.77	4.81	4.67	4.93	7.73*
		100.44	99.28	99.99	99.86	102.21

* Mean of three determinations.

Although the object of many of these analyses was only to determine the species, the material for investigation was selected with great care. Some of them, notwithstanding, contained minute quantities of corundum, by which the per centage of the silica or alumina is slightly increased; the majority, however, fully agree with the established composition of damourite, the constituents of which have the oxygen ratio: $RO : R_2O_3 : SiO_2 : H_2O = 1 : 9 : 12 : 2$.

Only the damourite from Crowder's Mountain would give for water the ratio : 3. This is the result of three determinations, all agreeing with each other. Some of the damourite varieties have a portion of the alumina replaced by the ferric oxide.

17. EPHESITE. LESLEYITE.

In his investigations on *emery*, J. L. Smith (*l. c.*) describes under the name "*ephesite*," a mineral which he states to have a lamellar structure and to resemble white cyanite. I will give below the analysis of ephesite, by Dr. Smith, and also one, which I made from material kindly furnished me by him for my investigations on corundum. It will be seen that they compare pretty well. I must add, however, that Dr. Smith's analysis should be considered the better, because he had a larger quantity and probably cleaner material for his examination. The main object of *my* analysis was to see whether ephesite contains a *mechanical admixture of corundum*, which was most conclusively proven.

Not having had an opportunity to see ephesite, Dr. Isaac Lea called (*l. c.*) a similar mineral from Unionville, *lesleyite*. He recognized the change of the hard corundum into soft minerals and in the absence of analyses, he considered all those which were fibrous and compact as identical. This is undoubtedly a very excusable error, because it is next to impossible to distinguish these minerals without chemical tests, and credit should be given to him for having brought to light these interesting varieties.

Of the fibrous and compact damourites I have already spoken, the margarite belonging here, I shall consider afterwards ; I now will dwell only upon such varieties, as have been generally recognized as *true lesleyites*. Some of these have been the subject of investigations by S. P. Sharpless,* and Dr. J. L. Smith,† and of observations by G. J. Brush.‡ There are three principal varieties of lesleyite.

a. The first is fibrous and divergent. It is slightly grayish-white, the surface is discolored by ferric hydrate, but interior of the mass appears to be free from it. Its lustre is pearly inclining to silky, it is scratched by fluorite, but scratches quartz easily, and is associated with scaly damourite.

b. The second variety resembles the first very much, but is more ferruginous and less pure; it is associated with damourite and pattersonite. It has small cavities through the whole mass. Its color is reddish.

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*S. P. Sharpless, Sill. Journ. [2] XLVII, 319.

†J. L. Smith, Sill. Journ. [2] XLVIII, 254.

‡G. J. Brush, Appendix to 5th edit. of Dana's Mineralogy, New York, 1872.

c. The third variety has frequently a chloritic mineral intermixed with it. The lesleyite itself is fine fibrous columnar, sometimes divergent; its color is between grayish-greenish and brownish-white, and its lustre between silky and vitreous. It is easily scratched by the knife, but is harder than apatite. Some parts of it scratch quartz.

Mr. Thos. M. Chatard and I analyzed the white variety *a*; and Dr. Koenig and I the varieties *b* and *c*; to which, for comparison, are added the analyses of S. P. Sharpless and J. L. Smith.

Ephesite:

	J. L. Smith.	Genth.
SiO_2 =	30.70	31.34
Al_2O_3	55.67	55.55
Fe_2O_3	——	1.04
MgO (trace MnO)	——	trace.
CaO	2.55	3.82
Li_2O	——	trace.
Na_2O	5.52	3.27
K_2O	1.10	1.68
Ignition	4.91	5.12
	100.45	101.72

The fusion with calcic carbonate with ammonic chloride gave me 10.26 *per cent. of corundum.*

The oxygen ratios for RO : R_2O_3 : SiO_2 : H_2O are:

Smith = 2.34 : 25.94 : 16.37 : 4.36 = 1 : 11.1 : 7 : 1.9

Genth = 2.22 : 26.20 : 16.72 : 4.55 = 1 : 11.8 : 7.5 : 2.0.

I have endeavored to calculate from these data the probable composition of this mixture, but failed. If we had any means to determine the *actual* amount of free corundum, *which I suppose will be between* 15 *and* 20 *per cent.*, we would propably have better success.

Lesleyite:

	a. White.			*b. Reddish.*		
	Genth.	Chatard.	Sharpless.	Genth.	Koenig.	O.W.Roepper
Sp. Gr. =		3.200	3.203		3.059	2.870
SiO_2 =	32.32	32.32	33.59	31.96	31.90	47.00
Al_2O_3	56.43	55.23	55.41	56.85	54.09	33.27
Fe_2O_3	0.29	———	——		0.51	2.84
MgO	0.38	0.73	——	0.13	0.34	——
CaO	0.32		——	0.13	——	——
Li_2O	faint traces.		——	faint traces.		——
Na_2O	0.32	0.64	——	0.35	1.01	——
K_2O	7.31	7.82	7.43	7.83	8.71	[illegible]
Ignition	4.01	3.86	4.30	4.09	4.20	[illegible]
	101.38	100.60	100.73	101.34	100.76	9[illegible]

In the analysis of *a*, I found by the fusion with calcic carbonate and ammonic chloride 21.40 per cent., and in *b*, 17.78 per cent. of *free corundum*.

The analysis of the reddish variety by C. W. Roepper contains evidently about 15 per cent. *of corundum in the silicic acid* which he found.

S. P. Sharpless suggested that both varieties are *the products of the action of water containing alkaline silicates upon corundum, and are more nearly related to pinite than to any other mineral species*; Prof. Brush, that both ephesite and lesleyite *are mixtures of corundum, and probably diaspore, with a mica, similar to the damourite found at the lesleyite locality; and that the foliated soft material is damourite or a hydrous mica near that species.*

In my investigations I had already ascertained that lesleyite contains a large per centage of free corundum, when I received the *Appendix to Dana's Mineralogy by Prof. Brush*, and I am happy to be able to prove that, at least, the greater part of his suggestions are correct.

I do not believe that there is any admixture of diaspore, but calculating from the amount of potash found in the white lesleyite the per centages requisite for a damourite, most similar in appearance to it (see analysis of damourite *e* by Dr. Koenig), we get:

$$\left.\begin{array}{lcr} SiO_2 & = & 31.87 \\ Al_2O_3 & = & 25.30 \\ Na_2O & = & 0.40 \\ K_2O & = & 7.31 \\ H_2O & = & 3.60 \end{array}\right\} = 68.48 \text{ Damourite.}$$

$$\begin{array}{rl} 30.00 & \text{Corundum.} \\ 1.52 & \text{Silicates, etc.} \end{array}$$

The analysis of Sharpless gives about 69 per cent. of damourite and nearly the same amount of corundum as my own.

The calculation of the analysis of the reddish variety gives less satisfactory results, owing to the greater impurity of the mineral; but it corresponds with about 70 per cent. of damourite, 27 per cent. of corundum and 3 per cent. of other admixtures.

c. The third variety of lesleyite is of an entirely different nature. The analysis gave:

		Genth.	Koenig.
Sp. Gr.	=	———	3.157
SiO_2	=	35.68	34.80
Al_2O_3		60.29	59.77
Fe_2O_3		0.72	0.73
MgO		0.29	———
Li_2O		faintest trace.	———
Na_2O		0.41	not det'd.
K_2O		0.96	not det'd.
Ignition		1.78	2.05
Corundum		———	2.20
		100.13	99.55

By the fusion with calcic carbonate and ammonic chloride I obtained 11.08 per cent. of corundum; the 2.20 per cent of corundum in Dr. Koenig's analysis remained unacted upon by the fusion with sodic carbonate.

The oxygen ratios in these analysis is for RO : R_2O_3 : SiO_2 : H_2O, as follows:

Genth = 0.39 : 28.32 : 19.03 : 1.58 = 1 : 72.6 : 48.8 : 4
Koenig = (0.39) ass'd : 28.07 : 18.56 : 2.05 = 1 : 72.0 : 47.6 : 5.3.

It will be seen that the ratio of R_2O_3 : SiO_2 is exactly = 3 : 2, which is that of fibrolite. Although it is very probable that this variety, like the two others is *originally an alteration of corundum into fibrolite*, the latter is almost completely changed in the first two varieties and to a great extent already in the third. I did not succeed in calculating from the small quantities of potash, soda and magnesia any of the admixtures. The 11.08 per cent. of corundum which I found, indicate the presence of probably about 15 or 16 per cent. of this substance.

18. PARAGONITE.

A highly interesting occurrence of corundum is that at "Ochsenkopf," near Schwarzenberg, in Saxony. It is found in granular masses or isolated grains of a blueish-gray color in a slaty rock of a brownish ash-gray color. Associated with the corundum are small scales of dark green chloritoid and a minute quantity of a foliated white brilliant mineral, which is probably diaspore. The slaty matrix consists of very fine white and brownish-white scales, and the whole appearance is so very similar to that of some varieties of damourite resulting from the alteration of corundum, that I considered a chemical analysis as very desirable. The material for it was selected with great care and was found to have the following composition:

SiO_2	=	43.70
TiO_2	=	3.50
Al_2O_3		39.60
Fe_2O_3		0.66
MgO		trace.
CaO		0.56
Li_2O		trace.
Na_2O		6.52
K_2O		0.93
Ignition		4.83
		100.30

The presence of titanic acid was surprising, as no rutile could be detected with a very good magnifying glass in any of the particles. Some of the slate was therefore carefully crushed without grinding and the lighter particles were washed off. The heavier residue, when examined under the microscope, showed numerous grains of yellowish-brown rutile.

Deducting this from the analysis, the composition of this slate is that of paragonite, the analyses of a variety of which, from St. Gothard by Rammelsberg, and of another from Pregatten, in Tyrol (Pregattite) by Oellacher, I will give for comparison :

	St. Gothard.	Pregatten.	Ochsenkopf.			
SiO_2 =	46.81	44.65	45.14	contains oxygen	24.07	
Al_2O_3	40.06	40.41	40.91	“ “	19.06	19.26
Cr_2O_3	——	0.10	——			
Fe_2O_3	trace.	FeO=0.84	Fe_2O_3=0.68	“ “	0.20	
MgO	0.65	0.37	trace.			
CaO	1.26	0.52	0.58	“ “	0.17	2.07
Na_2O	6.40	7.06	6.74	“ “	1.74	
K_2O	trace.	1.71	0.96	“ “	0.16	
Ignition=	4.82	5.04	4.99	“ “	4.44	
	100.00	100.70	100.00			

The oxygen ratio of RO : R_2O_3 : SiO_2 : H_2O is equal to 1 : 9.3 : 11.6 : 2.1 or very near to 1 : 9 : 12 : 2, which is that of damourite.

Paragonite is essentially a *soda damourite.*

The mineral from the Ochsenkopf analyzed by John does not belong to this species.[†]

I have above alluded to a peculiar rock, a slaty fibrolite with staurolite and cyanite, found in the neighborhood of Media, Delaware County, Pennsylvania, and also near the Culsagee Mine, in Macon County, North Carolina, and stated that the whole appearance of these slates was that of the paragonite slates of St. Gothard. After having already proved the alteration of corundum and fibrolite into damourite, and that of the Ochsenkopf corundum into paragonite, the question suggests itself—*may not the whole of the paragonite slates of St. Gothard and elsewhere be the result of the alteration of corundum or fibrolite?*

19. EUPHYLLITE.

Euphyllite accompanied by tourmaline and zoisite is a very rare associate of corundum at Unionville. It is undoubtedly like the others, resulting from its alteration. As I had not a sufficient quantity of pure material, no new analysis has been made, and really there was no necessity for it, because the analyses of Smith and Brush leave no doubt about its composition.

The micaceous mineral, which is found with the corundum and albite near Unionville, and which resembles muscovite, gave Dr. Koenig in two partial analyses about 42 per cent. of silicic acid.

This is undoubtedly the same as that analyzed by Sharpless[*] and those of a similar per centage of silicic acid from Asia Minor and Nicaria, analyzed by J. L. Smith.

20. JEFFERISITE.

Jefferisite, a species first distinguished by Prof. Brush, is frequently the result of the alteration of chlorite, hence indirectly of corundum. At the Unionville locality it is rarely met with, but sometimes it is found in irregular and imperfect hexagonal plates and crystals of a brownish-yellow color. It exfoliates like that from West Chester.

[†] Dana's Mineralogy, 5 edit., 482.

[*] Dana's Mineralogy, 5 edit., 489.

At the Culsagee Mine it is of more frequent occurrence, and the chlorite shows very often an incipient alteration by a discoloration of the laminae, which turns brown or brownish-yellow. It is generally found, when completely altered, in plated masses of a yellowish-brown color, which cannot be distinguished by their physical characters and their manner of exfoliation, from that of the original locality. There is another variety at the Culsagee Mine, which is associated with a considerable quantity of corundum. It occurs in fine greenish-brownish-yellow scales, not over one-eighth of an inch in diameter. It exfoliates, but not as remarkably as either of the other varieties.

The following were analyzed:

a. The broadly foliated, from the Culsagee Mine by Dr. Koenig (*a* 1) and Mr. Thos. M. Chatard (*a* 2).

b. The greenish-brownish-yellow fine scaly, by Mr. Thos. M. Chatard (*b.*)

c. and for comparison the broadly foliated from West Chester, by Dr. Koenig (*c* 1) and Mr. Thos. M. Chatard (*c* 2), to which is added (*c* 3) the analysis by Prof. Brush.

		Culsagee.			West Chester.		
		a. 1.	*a* 2.	*b.*	*c* 1.	*c* 2.	*c* 3.
SiO_2	=	33.93	33.77	34.00	33.35	34.40	37.10
Al_2O_3		17.38	17.56	20.36	17.78	16.63	17.57
Ee_2O_3		5.42	5.61	4.91	7.32	8.00	10.54
FeO		0.50	0.50[*]	0 42	2.11	2.11[*]	1.26
NiO		0.35	not det'd.	0.57	——	——	——
MgO		23.43	22.48	21.71	19.26	19.30	19.65
CaO		——	——	——	——	——	0.56
Na_2O		——	——	——	not det'd	not det'd	trace.
K_2O		——	——	——	"	"	0.43
Ignition		19.17	20.30	18.50	19.87	19.03	13.76
		100.18	100.22	100.47	99.69	99.47	100.87

The oxygen ratios for RO : R_2O_3 : SiO_2 : H_2O are as follows:

*a*1 = 2.94 : 3 : 5.59 : 5.26
*a*2 = 2.77 : 3 : 5.48 : 5.49
b = 2.43 : 3 : 5.00 : 4.50
*c*1 = 2.33 : 3 : 5.09 : 5.05
*c*2 = 2.42 : 3 : 5.42 : 5.00
*c*3 = 2.21 : 3 : 5.23 : 3.23

The discrepancies in these analyses hardly admit of constructing a formula. The analyses *a*1 and 2 give nearly $6RO + 2R_2O_3 + 5SiO_2 + 10H_2O$, and *b*, *c*1 and 2 nearly $5RO + 2R_2O_3 + 5SiO_2 + 10\ H_2O$.

The greatest, and to me unexplainable difference, exists in the results of Prof. Brush and Dr. Koenig and Mr. Chatard in the amount of silicic acid and water in the West Chester Jeffersite. Dr. Koenig made his analysis with finely powdered material, which has been exposed to the dry air of the room; Mr. Chatard took his material from another specimen, and after powdering, dried it for *four days over sulphuric acid in a vacuum;* in the same manner the Culsagee mineral was treated.

[*] Mr. Chatard determined only the ferric oxide, and took for the ferrous oxide Dr. Koenig's result.

21. CHLORITE.

I have mentioned in the geological outline, that chlorite rocks have been observed in almost every locality where corundum occurs in large masses or beds. It remains to examine into a number of peculiar associations between chlorite and corundum, in order to point out their relation to that of the entire chloritic beds.

a. Near Unionville, in the shaft alongside of the road to Kennett Square, chlorite occurs very conspicuously; it is intimately mixed with spinel, containing a considerable admixture of corundum (see above). The results of the explorations there, were not sufficiently encouraging, and the mining operations have therefore been abandoned. They have furnished, however, a few interesting scientific facts, as I have shown.

b. At the principal Unionville locality, chlorite is found under various circumstances. It sometimes forms a lining of minute dark green crystals, between the corundum and the foliated damourite; then, it is disseminated through the corundum in small scales or seams; and again it is met with, adjoining the large corundum bed, in boulder-like masses of fine scales, showing a lamination around a centre, which frequently, in breaking them open, consists of a nucleus of granular corundum. This chlorite is of a dull olive-green color, but often under the influence of the atmosphere, converted into reddish or yellowish-brown scales or even a ferruginous clay.

In a specimen in the University collection of nearly one foot in diameter, there seems to have been a fracture in the granular corundum, which allowed the liquid, producing the alteration, to percolate to the centre of the mass, and to deposit in the heart of the specimen, a small quantity of green chlorite, surrounded by a concentric layer of white granular corundum, upon which is a layer of scaly chlorite, slightly ferruginous and yellowish in immediate contact with the corundum, graduating into green. The whole nucleus, of about two inches in diameter is enveloped in a mass of yellowish-gray and brownish decomposed chlorite, of which I shall give two analyses by Dr. Koenig. (*b*, 1 and 2).

c. Another variety of chlorite from Unionville, originates from the alteration of damourite and tourmaline, which two minerals result from that of corundum. The white pseudo-fibrous variety of damourite (*c*), gradually assumes a slightly greenish tint from an admixture of fine scales of chlorite, which rapidly increases and soon form a massive variety of a light olive-green finely granular chlorite. The slender tourmaline crystals, which start in the white damourite, pass on into the chlorite, but for a short distance only; they are soon entirely altered into fine scaly chlorite, and these pseudomorphs of chlorite after tourmaline, are imbedded in the granular matrix like the original tourmaline. This is a highly interesting occurrence, and quite similar to that described by G. Rose (l. c.), as occurring in the chlorite slates associated with corundum, at Kassoibrod in the Ural.

Mr. Thos. M. Chatard has furnished me with two analyses, (*c*, 1 and 2) of this fine scaly granular chlorite, and another one, which I shall copy for comparison (*c.* 3) has lately been published by A. R. Leeds, in his contributions to mineralogy.*

d. The Culsagee Mine, near Franklin, North Carolina, has furnished a great variety of specimens of extraordinary interest.

There are some, which are aggregations of dark green foliated chlorite, having distinctly visible the rough outlines of hexagonal crystals of corundum, and in their centre the unaltered mineral; others again are more irregular in shape, and appear to have been fragments of massive corundum before they were converted. The nuclei of unaltered corundum, are often free from any admixtures, often, however, containing through their mass laminae of chlorite, at times in large quantities.

But there are frequently specimens met with containing *perfect and brilliant crystals* of corundum, which appear to have formed *after* a great portion of the original corundum had changed into chlorite, as if there had been an excess of alumina ready for combination, which, not finding a supply of the requisite amount of silicic acid and bases, had again crystallized as corundum.

The chlorite in immediate contact with the unaltered minerals, whether corundum or spinel, has often a fine scaly pseudo-fibrous structure, which at a greater distance assumes the more laminated shape; however, a great portion is laminated, where it touches either spinel or corundum, and in reality some of the largest plates, three or four inches in diameter, contain a considerable quantity of corundum disseminated through their mass.

The following varieties from the Culsagee Mine were analyzed; broadly foliated dark-green (*d*1) by myself, (*d*2 and 3) by Mr. Thos. M. Chatard, and a fine scaly variety diverging from corundum, (*d*4 and 5), by myself.

e. Similar nuclei of unaltered corundum in foliated chlorite have been observed amongst the specimens from Shooting Creek, Clay County, North Carolina.

The decomposed chlorites from Unionville gave:

		*b*1 *Brownish-red.*	*b*2 *Yellowish-gray.*
SiO_2	=	31.35	32.80
Al_2O_3	=	21.58	26.07
Fe_2O_3	=	14.17	9.80
MgO	=	16.67	17.70
Ignition	=	14.45	13.75
		98.22	100.12

The oxygen ratio of RO : R_2O_3 : SiO_2 : H_2O is very near = 1.5 : 3 : 3.5 : 2.5, which can be expressed by the formula: 2(3 RO, 2 SiO_2)

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*A. R. Leeds. Sill. Journ. [3] VI. 25.

+ ($4R_2O_3$, 3 SiO_2) + 10 H_2O, representing the product of the decomposition of chlorite.

		*c*1.	*c*2.	*c*3.
SiO_2	=	29.43	29.59	30.62
Al_2O_3		22.08	22.18	21.73
Fe_2O_3		1.41	1.33	0.42
FeO		5.64	5.77	5.01
MgO		28.46	28.54	29.69
Li_2O		not det'd.	not det'd.	0.11
Na_2O		"	"	0.14
Ignition		12.40	12 40	12.26
		99.42	99.81	99.98

		*d*1.	*d*2.	*d*3.	*d*4.	*d*5.
SiO_2	=	27.56	27.28	27.17	29.48	29.59
Al_2O_3	=	22.75	22.11	22.35	22.22	not det'd
Fe_2O_3	=	2.56	2.50	2.71	0.70	0.64
FeO	=	5.43	5.43	5.43	5.30	not det'd
(NiCo) O	=	0.30	0.41	0.26	0.11	"
MnO					0.17	"
MgO	=	28.47	28.34	27.73	30.99	30.88
Ignition	=	13.80	14.50	14.36	11.63	11.56
		100.87	100.42	100.01	100.60	

Particular attention was paid to the state of oxidation in which the iron exists; the ferric oxide is not due, as Prof. Leeds suggests, to *a superficial oxidation of some of the ferrous oxide in the mineral*, but is an essential constituent of the chlorites, and its presence makes a considerable difference in the relative proportions of the protoxidès and sesquioxides.

The oxygen ratio of RO : R_2O_3 : SiO_2 : H_2O of the analyses of chlorites, above given, is as follows :

*c*1 = 3.50 : 3 : 4.40 : 3.09
*c*2 = 3.50 : 3 : 4.40 : 3.08
*c*3[*] = 3.83 : 3 : 4.78 : 3.19
*d*1 = 3.66 : 3 : 4.20 : 3.55
*d*2 = 3.43 : 3 : 3.95 : 3.50
*d*3 = 3.30 : 3 : 3.87 : 3.41
*d*4 = 3.84 : 3 : 4.65 : 2.93

This is nearest to 7 : 6 : 8 : 6, which would correspond with the formula suggested by Rammelsberg :

$$4\,RO,\,SiO_2 + 3\,RO,\,2\,R_2O_3 + 6\,H_2O.$$

All these chlorites belong to the species, which was called ripidolite by G. Rose, but which is now distinguished by Dana as prochlorite.

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[*] Besides the printer's mistake in Prof. Leeds oxygen ratio, I have corrected it in accordance with my views about the state of oxidation of the iron.

Besides the jeffersite there appear to be other products of the alteration of chlorite, at the Culsagee Mine, Nos. 22 and 23, which appear to be new.

22. KERRITE (a new mineral).

It consists of innumerable fine scales, which under the microscope do not present a definite shape. They are very soft. Sp. Gr. = 2.303, Chatard. Their color is pale greenish-yellow with tint of brown; their lustre is pearly.

When heated they exfoliate, but not as much as jeffersite; B. B. melts to a white enamel. Chlorhydric acid decomposes it easily with separation of silicic acid in pearly scales. No corundum has been found in the scaly aggregates, but sometimes plates of green chlorite are intermixed with it. It is named in honor of Prof. W. C. Kerr, State Geologist of North Carolina.

It was analyzed by Mr. Thos. M. Chatard with material, which was examined under the microscope and apparently perfectly pure. He found:

				Mean.		Oxygen.
SiO_2	=	38.31	38.26	38.29		20.42
Al_2O_3	=	11.41	11.42	11.41	5.32	5.91
Fe_2O_3	=	1.93	1.97	1.95	0.59	
FeO	=	0.32	0.32	0.32	0.07	10.66
(NiCo) O	=	0.29	0.22	0.25	0.05	
MgO	=	26.30	26.50	26.40	10.46	
Ignition	=	21.22	21.28	21.25		18.89
		99.78	99.97			

The average of the two analyses gave the ratio of oxygen of RO : R_2O_3 : SiO_2 : H_2O = 5.4 : 3 : 10.3 : 9.5, which is nearly = 6 : 3 : 10 : 10, represented by the formula:

$$2(3RO, 2\,SiO_2) + (R_2O_3, SiO_2) + 10\,H_2O.$$

23. MACONITE (a new species).

This is another scaly mineral, and closely resembles a fine scaly jefferisite. The scales are slightly harder than the last, and under the microscope they are also irregular. Sp. Gr. = 2.827, Chatard. They are dark brown, their lustre pearly inclining to submetallic. When heated, exfoliates largely and fuses with difficulty to a brown glass. Easily decomposed by chlorhydric acid with separation of silicic acid in pearly scales.

Contains numerous fragments of dark blueish-gray corundum, and microscopic apparently triclinic brilliant reddish-brown crystals which may be *sphene*. Name from Macon County, North Carolina.

Two analyses of apparently perfectly pure material were made by Mr.

Thos. M. Chatard. The alcalies in the second analysis were determined by myself.

			Mean.		Oxygen.
SiO_2 =	34.24	34.20	34.22		18.25
Al_2O_3	21.41	21.66	21.53	10.03	13.75
Fe_2O_3	12.28	12.54	12.41	3.72	
FeO	0.32	0.32	0.32	0.07	6.98
(NiCo) O	0.11	0.13	0.12	0.03	
MgO	14.30	14.61	14.46	5.78	
Li_2O	trace.	trace.	trace.		
Na_2O	0.53	0.50	0.51	0.13	
K_2O	5.49	5.91	5.70	0.97	
Ignition	11.81	11.90	11.85		10.53
Corundum	0.20	——			
	100.69	101.77			

The oxygen ratio of an average of the two analyses for RO : R_2O_3 : SiO_2 : H_2O is = 1.52 : 3 : 3.98 : 2.3 = 3 : 6 : 8 : 5 nearly, giving the formula : $3 RO, 2 SiO_2 + 2 (R_2O_3, SiO_2) + 5 H_2O$.

About one-sixth of RO are alcalies R_2O.

24. WILLCOXITE (a new species).

There is still another mineral which appears to be new. It consists of white and greenish-white or grayish-white scales of a pearly lustre, and much resembles talc. B. B. in thin splinters, it fuses with difficulty into a white enamel; colors the outer flame yellow. With chlorhydric acid decomposed with difficulty with separation of silicic acid in pearly scales. It occurs sparingly, and I have seen it only in connection with corundum as a result of its alteration. One specimen from Shooting Creek, Clay County, North Carolina, is a fragment of a semiglobular mass, which probably once consisted entirely of corundum and which now has a nucleus of white lamellar corundum, invested with the scaly mineral. The largest diameter of the specimen is two and a-half inches, and that of the core of corundum three-fourths of an inch.

It is named in honor of Col. Joseph Willcox, who presented me with the specimen from Shooting Creek, and who possesses a still larger, but otherwise very similar one.

It is found more or less intermixed with white corundum at the Cullakenee Mine, in Clay County, and probably at the Culsagee Mine, in Macon County, if a specimen of a grayish and greenish-white scaly mineral with a nucleus of white corundum which I received from there, really comes from this locality.

Dr. Geo. A. Koenig furnished me with two analyses of this mineral (1) from material from the Shooting Creek specimen surrounding the nucleus of corundum, the other (2) from a piece from the Cullakenee Mine, Clay County, North Carolina.

		1.	2	Mean.	Oxygen.	
SiO_2	=	28.96	29.50	29.23	15.59	
Al_2O_3		37.49	37.56	37.52	17.48	17.88
Fe_2O_3		1.26	1.40	1.33	0.40	
FeO		2.44	2.38	2.41	0.54	9.53
MgO		17.35	17.20	17.28	6.91	
Li_2O		trace.	trace.	trace.		
Na_2O		6.73	6.24	6.48	1.67	
K_2O		2.46	2.42	2.44	0.41	
Ignition		4.00	3.32	3.66	3.20	
		100.69	100.02	100.35		

The oxygen ratio of RO : R_2O_3 : SiO_2 : H_2O = 1 : 1.88 : 1.64 : 0.33, which is nearest to 6 : 12 : 10 : 2, which can be expressed by the formula : 3 (2 RO, SiO_2) + 2 (2 R_2O_3, SiO_2) + 2 H_2O.

About one-fifth of RO are alcalies R_2O.

25. PATTERSONITE.

The chloritic mineral associated with the lesleyite at Unionville and described by J. Lea (*l. c.*) under the name of pattersonite, has been analyzed by S. P. Sharpless (*l. c.*) who determined, as he says, the potash by difference, and gives 11.35 per cent. of it. But (as Prof. Brush first pointed out) his analysis, exclusive of the potash, sums up only 78.64 per cent. A re-examination was therefore very desirable. Dr. J. Lea has very generously furnished for this purpose the material of this rare mineral, of which I have made the following analyses:

Sp. Gr. = 2.810.

		Nearly Pure.	Purest.				
SiO_2	=	29.89	29.90	contains	oxygen	15.95	
Al_2O_3		30.87	27.59	“	“	12.86	13.80
Fe_2O_3			3.12	“	“	0.94	
FeO		9.17	9.17	“	“	2.04	9.43
MgO		17.53	17.10	“	“	6.84	
Li_2O		trace.	trace.				
Na_2O		0.83	0.58	“	“	0.15	
K_2O		2.41	2.33	“	“	0.40	
Ignition		11.60	11.51	“	“	10.23	
		102.30	101.30				

The oxygen ratio of RO : R_2O_3 : SiO_2 : H_2O is = 2.05 : 3 : 3.47 : 2.22 = 6 : 9 : 10 : 6, corresponding with : 2 (3 RO, SiO_2) + 3 (R_2O_3, SiO_2) + 6 H_2O.

The oxygen ratio is very near that of thuringite, which is 1 : 1.5 : 1.5 : 1.

26. CHLORITOID.

This mineral has been observed at many of the corundum localities. It is associated with diaspore, mica and cyanite as Kassoibrod in the Ural; in Asia Minor with corundum, diaspore and margarite; at Chester, Massachusetts, with emery and diaspore. One specimen from Augusta County, Virginia, consists of chloritoid, damourite and grains of corundum; I found one little crystal in the washings of the soil from the Culsagee Mine. A very interesting occurrence is that in the pyrophyllite slates of Chatham County, North Carolina, where it occurs in minute shining scales of a dark blackish-green color disseminated through the white rock. With great difficulty I have selected a quantity of apparently pure material for analysis.

Sp. Gr. = 3.353.

SiO_2	=	26.13	contains oxygen = 13.94	
Al_2O_3		40.11	18.69	19.72
Fe_2O_3		3.44	1.03	
FeO		23.01	5.11	5.49
MnO		trace.		
MgO		0.94	0.38	
Ignition		6.91	6.14	
		100.54		

The oxygen ratio of $RO : R_2O_3 : SiO_2 : H_2O$ is $= 0.83 : 3 : 2.12 : 0.97 = 4 : 15 : 10 : 4$, giving the formula : $4\,RO, SiO_2 + 5\,R_2O_3, 4\,SiO_2 + 4\,H_2O$, which corresponds closer to my analysis than the formula $4\,RO, SiO_2 + 4\,R_2O_3, 3\,SiO_2$, which is generally given. However, there may have been a minute quantity of pyrophyllite in my material which might be the cause of this discrepancy.

27. MARGARITE.

This species had been known for a long time from one locality, Sterzing in Tyrol, but not until the almost simultaneous discovery of it in association with the corundum from Pennsylvania and North Carolina, by B. Silliman and with emery in Asia Minor and Greece by J. L. Smith, its importance became apparent. Since then it has been observed almost everywhere with corundum, but a great portion of the laminated varieties of damourite have been confounded with it; it so much resembles the latter in all its varieties, that the only safe way for distinction is by chemical analysis.

At Unionville, many of the corundum crystals have a coating of a soft mineral, and sometimes the whole mass of the crystals is converted into it; a qualitative analysis proved these coatings to be margarite. More fully investigated were the following varieties:

a. A part of a crystal, showing the basal plane *o*, and a pyramid, which seems to be $\frac{4}{3}2$ and consisting of a grayish-white soft mineral. To the naked eye it looks like an amorphous substance without lustre.

With a strong magnifying glass it is shown to be crystalline, and to consist of exceedingly minute scales with a pearly lustre, radiating from a nucleus of gray corundum, which occupies the centre of the crystal, so that the cryptocrystalline mineral has a somewhat fibrous (pseudofibrous) structure. On the outside of the mineral are small scales of damourite. I have made two analyses of the *purest* cryptocrystalline mineral, which closely corresponded, and of which I give below the mean result (*a*1.) For corroboration, I have made a third analysis of material, which was not as pure and contained a few scales of the damourite, the influence of which upon the analysis (*a*2.) will be noticed by the increased amounts of silicic acid and potash and a reduction in the quantity of lime.

b. A laminated white variety, having a very faint reddish tint, occurs rarely with the granular corundum recently discovered. It it associated with black tourmaline and forms a coating upon or small veins in the grayish-white corundum. The laminae are sometimes nearly one inch broad, but usually smaller. My analysis is given below (*b.*)

c. An aggregation of fine scales and laminae somewhat of a granular structure, also of a white color with a faint reddish hue, and associated with black tourmaline, appeared to be a mixture of margarite with corundum; on powdering, however, it was found to be almost free from the original mineral, which existed in it only in very minute grains. The carefully selected material was analyzed by Dr. G. A. Koenig (*c*).

d. A massive apparently compact or finely granular variety, has lately been found with the granular corundum; strongly magnified it appears as an aggregate of very small scales; on one side they are bounded by an aggregate of larger scales, intermixed with chlorite. Its color is white, but there are many ferruginous brownish-yellow spots disseminated through the mass. The purest which could be selected was analyzed by myself (*d*).

e. A compact variety, frequently containing fragments of unaltered corundum, has been analyzed by Mr. Thos. M. Chatard (*e*). It has a grayish-white to brownish-white color, and breaks easily into angular fragments of one or two inches in size, which are generally coated with hydrated ferric and manganic oxides. The margarite itself shows under the microscope a cryptocrystalline structure, it has a slight waxy lustre.

f. The margarite, which was found associated with the boulder of blue corundum, near the French Broad River, Madison County (formerly Buncombe County), North Carolina, has been analyzed by B. Silliman (l. c.).

g. At the Culsagee Mine, North Carolina, margarite is a rare mineral. I have noticed it only in a rock, consisting of a feldspathic mineral, mostly decomposed into kaolinite, a greenish hornblende, and small quantities of a chloritic mineral, the whole mass intermixed with white and pink corundum and laminae of margarite. (I have not mentioned this rock above, because its occurrence seems to be local and I have no further information about it).

The pure margarite is white and has a pearly lustre. It has been analyzed by myself (*g*1) and Mr. Chatard (*g*2).

h. The most beautiful varieties of margarite occur at the Cullakenee Mine, North Carolina. Here it occurs in groups of laminated crystals, distinctly showing the lateral planes of the same. The largest group, which I have seen is two inches long, one and a-half wide and five-eighths inches thick. The color of the basal cleavage planes is brownish-white, but after treatment with dilute chlorhydric acid, which removes a thin coating of ferric hydrate, the color is slightly pinkish-white with a hue of silver-gray ; the lateral planes have a darker color.

Tourmaline is sometimes inclosed between the laminae, and they are in some of the specimens intersected by crystals of an unknown mineral, to which I have already alluded. The most important association, however, are the nuclei of corundum, completely invested by the groups of laminated margarite. There are also scales of a bronze or brownish-yellow mineral, probably the result of the alteration of margarite, which I shall describe farther on as dudleyite. Mr. T. M. Chatard has analyzed this variety (*h*1).

Another from the same locality occurs as the product of the change of grayish-white corundum. It is frequently associated with zoisite, and intermixed with corundum in the form of broad laminae of a delicate pink color. I have made an analysis of it (see *h*2 below).

Associated with the mineral which I described as willcoxite, rarely occurs a somewhat fibrous variety made up of microscopic scales of margarite of a pearly lustre. It resembles much the variety of damourite *c*, but was found by qualitative analysis to be margarite, containing a considerable quantity of lime, but no potash. It completely surrounds a mass of gray corundum.

Still another variety from the Cullakenee Mine is found in thin seams of a grayish-green color. When magnified, the mineral consists of an aggregate of minute pearly scales of a greenish-white and sea-green color. I give the analysis, which I made under *h*3.

i. Crystalline masses of gray corundum from near Penland's, Clay County, North Carolina, which I have examined, are coated with a cryptocrystalline pseudofibrous mineral of a white and yellowish-white color, which gave by qualitative analysis, a considerable quantity of lime, but no potash, and which therefore appears to be margarite.

A similar coating containing lime, is sometimes found on the blue crystals of corundum from Crowder's Mountain, Gaston County, North Carolina.

These coatings on corundum crystals, which have been observed frequently, are sometimes not thicker than a thick varnish, sometimes the whole crystal has been altered, leaving not even a core of the original mineral.

k. I have above alluded to the kidney-shaped and irregular masses from Gainesville, Hall County, Georgia, which consist of a nucleus of corundum completely surrounded by margarite, and also by an earthy mineral with veins of foliated margarite through it. The margarite in contact with the grayish-white or pinkish corundum, is sometimes cryptocrystalline, pseudofibrous, but generally in aggregates of small pearly-white scales, of which I have made an analysis (*k*1). In the yellowish flesh colored mineral, the margarite is found in small veins consisting of pearly greenish-white scales, much resembling talc. My analysis (*k* 2) proved them to be margarite.

l. A beautiful white variety of broadly laminated margarite completely enveloping masses of cleavable corundum, has lately been discovered at Dudleyville, Alabama. The laminæ are sometimes two inches broad. I have analyzed it with the results given under *l.* This margarite appears to change into a bronze-colored or brownish-yellow mineral, of which I shall give a description below.

The following are the results of the analyses :

		*a*1.	*a*2.	*b.*	*c.*
Sp. Gr.	=	3.012	——		
SiO_2		32.19	33.46	30.70	31.48
Al_2O_3		49.62	——	49.33	49.01
FeO		0.91	——	0.39	0.52
MgO		0.41	——	0.76	0.54
CaO		7.81	7.05	11.86	10.70
Li_2O		trace.	——	0.36	1.34
Na_2O		4.78	4.41	0.96	
K_2O		0.57	1.02	0.65	
Ignition		3.93	4.94	5.91	3.94
Corundum		——	——	——	2.00
		100.22		100.92	99.54

		d.	*e.*	*g*1.	*g*2.	*k*1.
Sp. Gr.	=	3.047	3.00	——	3.087	2.900
SiO_2		30.45	31.29	28.11	28.80	29.34
Al_2O_3		50.86	47.24	49.16	49.57	48.73
FeO		0.42	0.85	0.43	0.34	0.78
MgO		0.37	0.88	0.45	0.75	0.78
CaO		12.13	10.86	11.08	11.33	11.32
Li_2O		trace.	trace.	0.45	not det'd.	trace.
Na_2O		1.72	2.66	0.67	"	2.61
K_2O		0.25	0.24	0.22	"	0.10
Ignition		4.48	5.92	6.43	6.64	6.55
Corundum		trace.	——	3.31	——	——
		100.68	99.94	100.31		100.21

		*h*2.	*h*3.	*k*1.	*k*2.	*l*.
Sp. Gr.	=	3.055	3.064	——	3.004	3.085
SiO_2		30.72	29.63	33.21	32.15	28.71
Al_2O_3		49.83	51.19	48.55	49.28	52.44
Cr_2O_3		——	0.13	——	——	——
FeO		0.84	0.59	0.46	0.57	0.39
MgO		0.76	1.09	0.39	0.63	0.74
CaO		10.84	11.28	10.04	11.09	11.52
Li_2O		trace.	——	trace.	trace.	0.38
Na_2O		2.19	1.22	1.64	1.18	0.67
K_2O		0.26	0.20	1.39	1.04	0.20
Ignition		6.21	4.73	4.59	4.16	5.40
Corundum		——	——	trace.	——	——
		101.65	100.06	100.27	100.14	100.45

It will be observed that in some of the margarites a considerable quantity of alcalies (R_2O), especially soda, replaces lime. This is especially the case with *a*1, in which one-third, and *e* and *h*1 and 2, in which about one-sixth of the lime is thus replaced.

Although many of these analyses were made only for the purpose of determining the species—in general they agree well with the established oxygen ratio for RO : R_2O_3 : SiO_2 : H_2O = 1 : 6 : 4 : 1.

Some contain a larger quantity of water.

I must not omit to notice here the description of a very important specimen which J. L. Smith (*l. c.*) gives in his memoir on emery: *A nodule, containing emery in the centre, with two concentric layers, the inner of chloritoid, the outer of emerylite (margarite).* In other words a pseudomorph of chloritoid and margarite after corundum!

28. EARTHY MINERAL FROM GAINESVILLE, GEORGIA.

Associated with and forming the matrix of some of the Gainesville margarite and resulting, like the latter, from the alteration of corundum is an earthy mineral, of which I have made an analysis. Its structure is finely granular; it is soft, but contains some hard particles which appear to be quartz. Its color is between isabel-yellow and flesh-color. Very minute particles of margarite are intermixed with it.

Sp. Gr. = 2.851.

Quartz	=	2.17			
SiO_2	=	28.84	contains oxygen	15.38	
Al_2O_3	=	39.65		18.48	19.12
Fe_2O_3	=	2.12		0.64	
MgO	=	1.26		0.50	5.10
CaO	=	14.75		4.21	
Na_2O	=	0.48		0.12	
K_2O	=	1.60		0.27	
Ignition	=	10.41		9.25	
		101.28			

The oxygen ratio of $RO : R_2O_3 : SiO_2 : H_2O = 1 : 3.75 : 3.01 : 1.8$, or very nearly $4 \cdot 15 : 12 : 7$, which gives the formula :

$$2\,(2\,RO, SiO_2) + (5\,R_2O_3, 4\,SiO_2) + 7\,H_2O.$$

Although the material was not quite pure, containing a very minute quantity of margarite, I wish to put this analysis on record, believing the mineral to be new, and wishing that it may be found in a state of greater purity.

29. DUDLEYITE (a new species).

At the Cullakenee Mine, but in larger quantity with the margarite of Dudleyville, Alabama, a soft bronze or brownish-yellow mineral is found, which is probably the result of the alteration of margarite and still retains its form ; lustre pearly. When heated, it exfoliates very slightly and then melts with difficulty into a brownish-yellow plebby mass.

With chlorhydric acid decomposed easily with separation of silicic acid in pearly scales. It is named after the locality, Dudleyville, Alabama.

The analysis gave :

SiO_2	=	32.42	contains oxygen	17.29	
Al_2O_3		28.42		13.24	14.74
Fe_2O_3		4.99		1.50	
FeO		1.72		0.38	7.71
MgO		16.87		6.75	
Li_2O		0.19		0.10	
Na_2O		1.52		0.39	
K_2O		0.56		0.09	
Ignition		13.43		11.94	
		100.12			

The oxygen ratio for $RO : R_2O_3 : SiO_2 : H_2O$ is $= 1 : 1.91 : 2.24 : 1.55$, which is very near $6 : 12 : 14 : 10$, giving the formula : $2\,(3\,RO, 2\,SiO_2) + (4\,R_2O_3, 3\,SiO_2) + 10\,H_2O$.

30. LAZULITE.

In mentioning the alteration of the corundum of Crowder's and Clubb's Mountains, Gaston County, North Carolina, I observed that in all these localites, and others which I considered as analogous, *lazulite* was one of the results of alteration.

I have seen specimens from the Gaston County localities which were mixtures of lazulite and damourite, and, what is very significant, lazulite, which inclosed crystals of rutile, the constant associate of the corundum at these localities.

Although not in accordance with the views of modern chemistry, I hope that I will be justified in having attempted to give the composition of these minerals in formulæ, which, as we once thought, would express an idea of the rational composition of the species. I do not intend to discuss their merits, I will even admit that such formulæ state a great deal more than what with our knowledge of the subject, we have a right to express. Yet there are so many geologists and mineralogists, who have familiarized themselves with this mode of expression, that I thought it an injustice to them to give merely the empirical composition.

After having thus given the above data, the conclusions arrived at by this investigation are :

That, at the great period when the chromiferous chrysolite beds (in part subsequently altered into serpentine, etc.) were deposited, a large quantity of alumina was separated which formed beds of corundum ;

That, this corundum has subsequently been acted upon and thus been changed into various minerals, such as spinel, fibrolite, cyanite, and perhaps into some varieties of feldspar, also into tourmaline, damourite, chlorite and margarite ;

That, a part of the products of the alteration of corundum still exists in the form of large beds of mica-(damourite) and chlorite-slates or schists ;

That, another part has been farther altered and converted into other minerals and rocks, such as pyrophyllite, paragonite, beauxite, lazulite, etc.

The question has often been asked me, how I could explain these wonderful changes which have taken place with a substance so absolutely insoluble as corundum? My answer is that I know nothing about it. I have in this whole investigation carefully avoided making any statements which are not based upon undeniable facts; in a few instances only, where the facts were very strong in my favor, I have allowed myself to judge from analogy.

Mr. S. P. Sharpless is probably correct in his supposition that corundum has been altered into lesleyite and pattersonite by the action upon it of water containing alcaline silicates. Such a view is very plausible, especially if we add an elevated temperature and great pressure. I have tried a number of experiments in this direction. I have put corundum reduced to an impalpable powder, and subsequently boiled out with chlorhydric acid and washed with water, into a glass tube with a solution of potassic silicate, and after sealing it have exposed it to a temperature, which was gradually increased to about 250° C. With one exception, all my tubes burst before the alcaline silicate had time to act upon the corundum. In this one case the tube stood for about three days and nights, before it exploded. The scales of the mineral substance, which came from the tube were carefully collected, washed out and then treated with dilute chlorhydric acid and evaporated to dryness, the residue moistened with chlorhydric acid, the mass extracted by water. The clear liquid gave with ammoniac hydrate a trace of a flocculent precipitate, which appeared to be alumina. The quantity was too small, however, to place any value upon this experiment. It may be well to mention in this connection that under pressure and reduced to a fine powder, corundum dissolves with considerable facility in dilute sulphuric acid, as I have already stated above.

I hope that the time may soon arrive when we shall have a clear insight into the alterations of corundum, which I have above described. At present we have no facts upon which a tenable theory could be built.

And this finishes my task. I have devoted to it my leisure hours for over two years. Nobody can be more aware of the many imperfections of this investigation, but I hope that it will be taken into consideration that I have labored under very great disadvantages. I had for consultation neither a collection to compare my specimens with those from other parts of the world, nor a library of sufficient completeness. All that I have done, I have done with my own labor and the assistance of many kind friends, to whom I am under great obligations; of the many who helped with specimens, etc., I will especially mention Rev. Dr. E. R. Beadle, Prof. G. J. Brush, Dr. Isaac Lea, Dr. Joseph Leidy, Rev. C. D. Smith, of Franklin, North Carolina; Prof. E. A. Smith, of Tuscaloosa, Alabama, and Col. Joseph Willcox; the greatest gratitude I owe to my assistants, Dr. Geo. A. Koenig and Thos. M. Chatard, S. B., for the many valuable analyses which they made, and which alone have enabled me to finish this work in this comparatively short time.

University of Pennsylvania, August 18, 1873.

POSTSCRIPT.

Since writing the above, an article has appeared in the September number of the American Journal of Science and Arts, entitled "Notes on the Corundum of North Carolina, etc., by J. Lawrence Smith, Louisville, Kentucky," which contains analyses of a few species, discussed in my paper.

There are a few points to which I wish to call attention.

Under "*zoisite*," Dr. Smith gives analyses of two minerals, which, in my opinion, do not belong to this species. The "*light green*," analyzed by Tho. M. Chatard and described as Smaragdite(?) (Kokscharoffite), is probably an aluminous hornblende (?), the black variety is evidently the same mineral, containing, however, as proved by Dr. Smith's analysis, a part of the alumina replaced by ferric oxide. The zoisite from Cullakenee is *always white* with only a *slight grayish* or *greenish tint*.

The granular "*andesite*" gives, according to his analysis, the oxygen ratio 0.85 : 3 : 9.09, which is very near = 1 : 3 : 9, placing this mineral, like that from Chester, Massachusetts, under *oligoclase*.

Philadelphia, August 28, 1873.

CONTRIBUTIONS TO A KNOWLEDGE OF THE CURCULIONIDÆ OF THE UNITED STATES.

By George H. Horn, M. D.

(*Read before the American Philosophical Society, September* 19, 1873.)

The following pages have been prepared as a beginning of the systematic study of the *species* of Curculionidæ inhabiting our country. It is to be regretted that this family has been almost entirely neglected by our students, so much so, in fact, that the large majority of the species have been described abroad, and, with the exception of several genera revised by Dr. Leconte, no genus has ever been studied as a whole by American students. It is hoped that the present essay may show that the study of this family is by no means as difficult as has been supposed. The field being almost entirely new, numerous opportunities are afforded for research, and without doubt characters remain to be developed having an important bearing in the systematic arrangement of the family.

One character is mentioned in the following pages that appears to have escaped notice. In most if not all the genera of *Mecorhynques*, the males have eight and the females seven dorsal abdominal segments. The *Calandrides* and *Cossonides* appear not to possess this character, as also all the *Brachyrhynques* which I have had time to examine.

The synonymy of our *Curculionidæ* is at times troublesome to unravel, and many species have been described from slight varieties. On the other hand, many are unnamed, and it is probable that number of species at present given in catalogues is not far behind the total, as the unnamed species will about fill the blanks caused by the correction of synonymy.

All of the genera in the following pages have become familiar to students in an empirical manner, consequently little is said concerning the genera themselves, this work being left to the continuation of the "Classification of the Coleoptera of North America," which will doubtless soon appear, from the hands of Dr. Leconte.

The first part of the present essay contains the *Calandrides* and *Cossonides* forming the entire representation of the genera and species of Phalanx II, Cohort II., Legion II., according to the system of Lacordaire, which occur in our fauna. The remaining pages are devoted to such isolated genera as appear to stand in need of elucidation.

CALANDRIDES.

The tribe Calandrides is divided by Lacordaire into six groups, of which three only have representatives within our faunal limits.

Metathoracic episterna very broad, epimera large.................................. RHYNCHOPHORIDES.
Mesothoracic epimera acute above, ascending.................................. Rhynchophorus.
Metathoracic episterna moderate.

Mesothoracic epimera truncate above...... SPHENOPHORIDES.
Spongy portion of antennal club retracted, that is, visible at the tip only. Prosternum narrow...................... SCYPHOPHORUS.
Spongy portion of club large, occupying at least a third of the tip.
Anterior coxæ widely separated, prosternum between the coxæ as wide as the diameter of a coxal cavity.. METAMASIUS.
Anterior coxæ approximate, prosternum linear........................ RHYNCHOPHORUS.
Mesothoracic epimera acute above......... CALANDRIDES.
Prosternum widely separating the coxæ CALANDRA.

RHYNCHOPHORUS Herbst.

R. cruentatus Fab. Syst. Ent., p. 128; Herbst, Coleop. 6, pl. 61, fig. 2; Oliv. Ent. V., 83, p. 82, pl. 12, fig. 147; *Zimmermanni* Fahrs. Schönh. Gen. Curc. viii., pt. 2, p. 219.

Above sub-depressed, sub-opaque, velvety, color variable. Rostrum longer than half the thorax, apical portion sparsely punctured, at base roughly punctured. Thorax one-fourth longer than wide, elliptical, apex suddenly constricted, sides feebly, base more decidedly arcuate, surface sparsely and minutely punctulate. Scutellum elongate, feebly elevated along the middle, attenuate at apex. Elytra conjointly emarginate, humeral angles broadly rounded, sides feebly convergent behind, apices truncate, surface nine striate, outer four striæ feebly impressed, inner five deep, at bottom punctured, inner intervals feebly convex, outer flat. Pygidium sparsely and coarsely punctured, more densely at apex. Body beneath shining, sparsely and very minutely punctulate. Last ventral segment at the latero-dorsal region, coarsely punctured and with a line of yellowish hairs. Anterior tibiæ densely fimbriate with long yellowish hairs, middle and hind tibiæ less fimbriate, femora beneath fimbriate. Anterior tibiæ within mucronate at apex, externally bidentate, middle and hind tibiæ broadly rounded at tip, mucronate within. Tarsi with the third joint moderately dilated and densely pilose along the anterior margin. Length .8–1.0 inch; 20–25 mm.

Var. *Zimmermanni*, Fah. Body above and beneath totally black.

Var. *cruentatus*, Fab. Thorax red, sides broadly margined with black, and a median black stripe, elytra black with red spots. Body beneath piceous, legs and abdomen paler.

Var. ———. Body above in great part red, lateral black spaces of thorax wanting, median stripe more or less divided, elytra in great part red with black spots of varying number and size. Pectus black, abdomen and legs red.

The above varieties run together by very gradual changes of color. Although the term "red" is used, the color is not properly red, but a dark velvety crimson, which, however, also varies in shade.

Fabricius' name appears to have been lost sight of entirely by the authors of Gen. Curc., notwithstanding the very fair figures (exaggerated in color) given by both Herbst and Olivier.

Occurs from South Carolina to Louisiana.

SCYPHOPHORUS Schönh.

Antennal club with spongy space retracted, visible only at the tip. Anterior tibiæ bidentate externally at tip, middle and hind tibiæ with the outer angle bispinous. Third joint of all the base broadly dilated fimbriate beneath along the anterior margin.

The species in our fauna are as follows:

Thorax sparsely punctured, punctures of the disc much finer.
  Elytral intervals feebly convex, irregularly biseriately punctulate.. acupunctatus.
Thorax very coarsely and deeply punctured.
  Elytral intervals flat, irregularly biseriately punctulate robustior.
  Elytral intervals flat, with a single series of coarse punctures.. Yuccæ.

S. acupunctatus Gyll. Schön. Gen. Curc. IV., p. 857; *asperulus* Lec. Pacif. R. Rep. 1857, p. 58.

Black, shining, feebly convex above. Rostrum three-fourths the length of thorax, sparsely and finely punctured at the sides, more coarsely punctured at base. Thorax longer than wide, anteriorly moderately constricted, base broadly arcuate, sides in front strongly arcuate and rapidly widening, at middle feebly arcuate and very slightly narrowing to base; surface sparsely and finely punctured, punctures at sides coarser and sub-muricate. Scutellum slightly impressed. Elytra not wider than thorax and but one-fourth longer, surface striate, striæ coarsely but not closely punctured, intervals moderately convex. finely biseriately irregularly punctulate. Pygidium sparsely punctured at base, more densely and very coarsely at base. Body beneath coarsely punctured. Tibiæ sparsely fimbriate within, femora coarsely punctured beneath, each puncture bearing a tuft of short, yellow, stiff hairs. Length .40–.50 inch; 10–13 mm.

Occurs from Mexico to California.

S. interstitialis Gyll., Cuba, is very closely allied to the preceding.

S. robustior n. sp.

Black, sub-opaque, Rostrum three-fourths the length of thorax, at sides minutely punctulate, at sides of base coarsely punctured. Thorax moderately convex, apex constricted, sides arcuate in front, becoming gradually broader, at middle and to base sub-parallel, base feebly arcuate, disc coarsely but sparsely punctured, punctures denser, coarser, and deeper at the sides. Scutellum sulcate. Elytra convex, opaque, striate, striæ coarsely and rather closely punctured, intervals feebly convex, finely and irregularly biseriately punctulate. **Pygidium** sparsely punctured, at base finely, at apex coarsely and deeply. Body beneath coarsely foveato-punctate. Legs as in *acupunctatus*. Length .50 inch ; 13 mm.

Closely allied to *acupunctatus*, but opaque, and with the thorax very much more coarsely punctured. Its form is also more robust.

One specimen in Cab. Leconte, from.

S. Yuccæ, n. sp.

Black, sub-opaque, depressed. Rostrum nearly as long as thorax, coarsely and deeply punctured at base and gradually more finely to apex. Thorax nearly as broad as long, apex constricted, thence becoming rapidly broader, sides feebly arcuate, at base slightly broader, surface very coarsely punctured, punctures slightly more dense at the sides. Elytra deeply striate, striæ not conspicuously punctured, intervals flat with a single series of moderately coarse, rather closely placed punctures. Scutellum not channelled. Pygidium at basal fourth finely punctured, the remainder coarsely and very deeply punctured. Body beneath more shining than above, coarsely, deeply, and rather closely punctured. Femora coarsely and submuricately punctured. Length .40–.64 inch; 10–16 mm.

Male. Anterior tibia sub-dentate at basal fourth, densely pubescent on inner side, middle and hind tibiæ sparsely pubescent, and at basal fourth a short, broad, obtuse tooth.

Female. Tibiæ not dentate within, sparsely fimbriate.

Differs abundantly from any described species by its more depressed form and the interstitial punctuation.

Occurs in the southern portion of California, and feeds on the Yucca gloriosa, on which plant it is found in the spring, at the base of the flower stalk. Specimens were collected by Mr. Wm. M. Gabb, others have been sent by Mr. Jas. Behrens, collected at San Diego.

METAMASIUS, n. g.

The above name is suggested for various species at present retained in Sphenophorus, differing only in the very widely separated anterior coxæ. The prosternum is as wide, or nearly so, as the diameter of one of the coxal cavities. The third tarsal joint is broad and densely pubescent beneath as in the first group of the following genus.

One species occurs in our fauna, although many others probably belong to the genus, among them *Sphen. carbonarius*, Chevr., from Mexico.

M. sericeus Latr. Humb. et Bonp. Voy. I., p. 206, pl. 22, fig. 4; Oliv. Ent. V., 83, p. 84, pl. 28, fig. 409; Gyll. Schön. Gen. Curc. IV., p. 896.

Elongate, feebly convex, opaque. Rostrum rufous, longer than half the thorax, finely punctured at the sides, more evidently punctured at base; above finely channeled at base and a puncture between the eyes. Thorax red, subopaque, at sides a short black stripe ; at middle an entire broad line, and at base, on each side of middle, a triangular spot black,

S. vomerinus Lec. Proc. Acad., 1858, p. 81.

Black, sub-opaque or very feebly shining. Rostrum slightly longer than half the thorax, moderately robust, compressed, upper edge sparsely punctured at base, very finely grooved and with an impressed puncture between the eyes. Thorax longer than wide, somewhat variable in form, usually oblong rarely sub-quadrate, sides very feebly, base less arcuate, surface equally punctured over the entire surface, rarely with an obsolete smooth median space, punctures coarser at the sides and base, and also more dense before the scutellum. Scutellum smooth, not channeled. Elytra broadest slightly behind the base, and gradually narrower to apex, surface deeply striate, striæ distantly punctured, intervals flat, sub-equal, sometimes alternating and coarsely uni- or bi-seriately punctured. Pygidium coarsely and at apex sub-confluently punctured. Body beneath sparsely punctured. Length .24–.36 inch ; 6–9 mm.

Var *baridioides*. Elytral intervals sub-equal, uni-seriately punctured.

The sexes do not differ remarkably. The tibiæ are very sparsely fimbriate within and the anterior are feebly sinuate. The sub-apical spur is moderate.

The elytral intervals vary in the degree of punctuation and also in width. In the typical form the intervals are slightly alternately broader, and the narrower space distinctly uni-seriately punctulate, and the broader intervals bi-seriately or even confusedly punctured. In the variety *baridioides* the intervals are equal and uni-seriately punctulate with coarser punctures than in the preceding variety. These latter seem almost entitled to rank as distinct species, but every necessary link between the two forms exists. The legs are sometimes rufous.

Colorado, Arizona, and California east of the Sierras.

S. Ulkei, n. sp.

Black, shining, form and aspect of *placidus*. Rostrum longer than half the thorax, moderately arcuate, compressed, surface moderately punctured, at base a fine channel terminating in a moderately deep foveæ between the eyes. Thorax longer than wide, anteriorly moderately constricted, sides in front rather strongly arcuate, behind the middle feebly arcuate and narrowed to base, surface moderately convex, without vittæ but with a slight impression at middle, behind the anterior constriction (as in *placidus*), and a V-shaped impression behind, more coarsely punctured, the remainder of the surface sparsely and finely punctured becoming more dense toward the sides and coarse at the basal angles. Scutellum feebly concave. Elytra oval, sides feebly arcuate and slightly narrowed toward the tip, surface finely striate, striæ not punctured but interrupted by large shallow foveæ moderately approximated ; intervals slightly unequal, the sutural, 2–4–6–8 bi-seriately finely punctulate at base, gradually becoming uni-seriate at apex, narrower intervals uni-seriately punctulate. Pygidium coarsely and deeply punctured, apex and base more finely and the former more densely punctulate.

Body beneath sparsely and moderately finely punctured. Last ventral segment with a small fovea made up of coarse confluent punctures. Anterior tibiæ with the outer apical angle prolonged, middle and hind tibiæ truncate. Length .32 inch; 8 mm.

Occurs in Nebraska, Colorado, New Mexico, Wyoming.

S. inæqualis Say. Curc. p. 23; Am. Ent. edit. Lec. I., p. 291; *contractus* Gyll., Schönh., Curc. IV., p. 953.

Form robust, color black, upper surface with luteous acquired coat. Rostrum three-fourths as long as thorax, slightly compressed, sparsely punctured at base, finely canaliculate and with a slight fovea between the eyes. Thorax constricted in front, longer than wide, oval, base less arcuate, surface coarsely foveato-punctate with normally five smoother spaces, one median entire line dilated in front of middle to a rhomboid spot, two irregular sub-basal and two sub-apical spaces which may unite in a sinuous line. Scutellum broadly channeled. Elytra scarcely longer than the head and thorax, widest behind the base, rapidly narrowing to apex, surface striate, striæ with coarse, very distant punctures, intervals flat, undulating, closely and coarsely punctured; humeral prominence and a slight tuberosity at the apex of the intervals 5–6–7 more shining. Pygidium coarsely and densely punctured at apex. Body beneath black, shining, coarsely but sparsely punctate. Tarsi piceous. Length .24 inch; 6 mm.

Occurs in the Gulf States.

Group II.

The species of this group are few in number in our fauna, and are thus distinguished:

Body above red, with black spots varying in size and color... 13-punctatus
Body above brownish, or piceous, irrorate.................. pustulosus
Body above entirely black, sub-opaque.................... validus

S. tredecimpunctatus Illig. Schneid. Magaz. V., p. 613; Hbst. Käf. VI., p. 10, pl. 60, fig. 5; Gyll. Schönh. IV., p. 898; *cribarius*, Fab. Oliv. Ent., V. 83, p. 88, pl. 28, fig. 112, b; *quinquepunctatus*, Say. Am. Ent., edit. Lec., p. 19, pl. 9; *variabilis*, Gyll. loc. cit., p. 899; *anceps*, Gyll. loc. cit., p. 894.

Many other synonyms are recognized in the catalogues, and many more will doubtless be added after a little examination, but these are all which have been made upon specimens from our fauna, and it is unnecessary to mention others from Mexico southward.

Body beneath black, pruinose, above red with black spots, five on the thorax, and four on each elytron, arranged as follows: thorax with a median elongate oval spot, two at the base, touching the margin or distant from it, two spots anteriorly forming a quadrangle with the basal spots, elytral spots four on each, one behind the humeral prominence, two median arranged transversely, one sub-apical, more or less transverse. The elytral spots have a tendency to become confluent, and specimens occur with the entire surface black, margined at the sides with red. Rostrum black, longer than half the thorax, sparsely punctured, and finely grooved at base. Thorax longer than wide, apex constricted, sides in front strongly arcuate, behind sub-parallel, surface sparsely punctured. Scutellum feebly grooved. Elytra finely striate, striæ finely and distantly punctured, intervals flat, impunctured. Pygidium perforato-punctate at apex, more finely and densely punctured at base. Body beneath sparsely punctured. Length .28–.40 inch; 7–10 mm.

In well preserved specimens the upper surface is slightly pruinose.

Occurs over our entire country, from the Atlantic to the Pacific, and southward through Mexico.

S. pustulosus Gyll. Schönh. Curc. IV., p. 923.

Body beneath black with luteous, sub-sericeous efflorescence. Rostrum three-fourths the length of thorax, sparsely punctulate at base, slightly canaliculate, punctured, each puncture surrounded with luteous efflorescence. Thorax longer than wide, anteriorly slightly constricted, sides feebly arcuate, gradually divergent to base; surface brownish, at sides darker, opaque, surface sparsely punctured, each puncture with luteous area. Elytra slightly narrower to apex, surface brownish, opaque finely striate, striæ distantly punctured, intervals flat, distantly uni-seriately punctulate, punctures of striæ and intervals with luteous area. Scutellum luteous. Pygidium very coarsely perforato-punctate at sides and apex. Body beneath sparsely punctate. Length .40–.44 inch; 10–11 mm.

The punctures of the surface being surrounded by a round luteous area, gives the aspect of a very coarse punctuation.

Occurs in Arizona.

S. validus Lec. Proc. Acad. 1858, p. 80; *procerus*, Lec. loc. cit.

Black, sub-opaque, or with a slight velutinous aspect. Rostrum nearly as long as thorax, strongly arcuate at tip, finely punctured, a puncture at base between the eyes. Thorax sub-depressed, apex feebly constricted, sides moderately arcuate, gradually diverging and at basal fourth, sub-parallel; surface very sparsely and finely punctulate. Elytra rapidly broader behind the base, then gradually narrowed to tip, basal margin slightly reflexed, surface finely striate, striæ distantly and obsoletely punctulate, intervals flat, very minutely punctulate. Pygidium coarsely perforato-punctate and slightly more convex along the median line. Body beneath black, sub-opaque, sparsely punctured, abdomen more coarsely punctured. Length .60–.90 inch; 15–23 mm.

Male.—Anterior tibiæ densely fimbriate within with long-yellowish hairs, middle tibiæ fimbriate with shorter hairs, hind tibiæ with very short black hairs.

Female.—Tibiæ within fimbriate, with short hairs.

This species is the largest Sphenophoride in our fauna. I find specimens from Mexico labelled *fuliginosus* Chev., but no such species is known to me, nor do I find any description of a similar species. It may however be described, and I quote the name that the synonymy may be determined.*

Occurs in Sonora, southern California and Mexico.

Group III.

This group contains species of moderately large size, all characterized by the presence of a *natural* glabrous coating, which may be more or less removed by abrasion, and is sometimes almost entirely lost on the upper surface, but always exists beneath. The third tarsal joint, of all the feet, is dilated and densely pubescent beneath, excepting a median space.

The species are as follows:

Body above densely clothed with a glabrous *natural* coat, disc of
thorax flattened, three vittæ distinctly indicated. Abdomen
♂ sparsely hairy along the middle........................**ochreus.**
Body above almost entirely denuded. Abdomen ♂ glabrous....
Striæ of elytra coarsely punctured..........................**discolor.**
Striæ finely and distantly punctured........................**pictus.**

These species are exactly similar in form, and very closely allied.

S. ochreus Lec. Proc. Acad. 1858, p. 89; *? æqualis*, Gyll. Schönh. Curc. IV., p. 941.

Body black, entirely covered with a *natural* glabrous coat, varying in color from pale ochreous to plumbeous. Rostrum as long as three-fourths of the thorax, compressed, slightly broader at tip, sparsely punctured, at base very finely grooved, between the eyes a moderately deep impression. Thorax longer than wide, apex slightly constricted, anteriorly rapidly broader to apical fourth, sides thence sub-parallel, base feebly bisinuate; disc sub-depressed, with three entire vittæ indicated, surface sparsely and coarsely punctured between the vittæ, punctures coarser at base, vittæ minutely punctulate very rarely denuded. Scutellum sub-sulcate. Elytra slightly broader behind the base gradually narrowed to tip, surface finely striate, striæ moderately, coarsely punctured, intervals flat, alternately broader, the broader intervals bi- or tri-seriately punctulate, the narrow uniseriately, and with coarser punctures, the broader intervals frequently darker in color. Pygidium coarsely punctured and with a slight tuft of hairs at each side of the tip. Body beneath and legs sparsely punctured and coated. Length .44-.68 inch; 11-17 mm.

Male.—Metasternum and abdomen broadly concave, the latter sparsely villous along the middle. Femora beneath, and tibiæ within sparsely fimbriate with yellowish hairs.

Female.—Abdomen convex, not villous, legs less fimbriate.

This species varies as above indicated in the color of its glabrous coat, from pale ochreous to plumbeous and cinereous. The type specimen does not differ notably from the specimens from this side of the Mississippi, except that the summits of the thoracic vittæ have become denuded.

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* I have since been informed by M. Aug. Sallé. that this is merely a Catalogue name.

Occurs from Canada to Arizona. It is possible that this is the species described by Gyllenhal as *æqualis*, and if so it has evidently been placed in the wrong *Strips*, and should my surmise prove correct, this name has priority, and must be used in place of *ochreus*.

S. discolor Mann. Bull. Mosc. 1843, II., p. 293; Schönh. Gen. Curc. VIII., 2, p. 246.

Closely allied to *ochreus*, differing as follows:

Thorax regularly convex, vittæ scarcely indicated, surface denuded, except a narrow space at the sides, sparsely punctured, punctures at the median basal region coarser and denser. Elytra almost entirely denuded, rarely with the narrower intervals coated, striæ moderately deep, coarsely and rather closely punctured. Body beneath entirely coated. Length .48–.64 inch; 12–16 mm.

Male.—Abdomen longitudinally concave, not villous.

Female.—As in *ochreus*.

S. pictus Lec. Proc. Acad. 1858, p. 80.

Thorax coated, vittæ distinctly limited by punctures, and deprived of coat, surface sparsely punctured, over the entire surface, and not denser at base. Elytra entirely denuded except the entire second, the fourth and sixth at base and the lateral region. Pygidium sparsely and less coarsely punctured than in the two preceding species. Length .64 inch; .16 mm.

Sexual characters as in *ochreus*. The elytral striæ are fine, finely and distantly punctured, the intervals flat, punctulate with the tendency to alternation of puncturing almost obliterated.

One specimen, Vallecito, California.

One other character may be noted as separating these species from those of the next group, with which I suspect *ochreus*, has been confounded. The thoracic vittæ are entire, and the lateral does not send a branch from the outer side to the base.

Group IV.

The third joint of the anterior and middle tarsi are dilated and pubescent at the sides, the hind third tarsal joint is usually conical, very rarely feebly dilated, and at the sides sparsely fimbriate.

From the characters of the table, this group can only be confounded with the preceding, in the former, however, the natural glabrous coat is always present, here never. The lateral carina of the thorax at basal half is here always bifid, that is, sends a branch from its middle which attains the hind angle of the thorax. In the next group the tarsi are slender, and sparsely fimbriate, never pubescent at the sides.

Elytral intervals, either flat or alternately elevated, in their entire length; striæ moderately finely punctured.
  Thoracic smooth lines unequal among themselves, and of varying width, sometimes obliterated.
    Elytral intervals more or less convex, always alternating, striæ moderately deep................................ pertinax.
    Elytral intervals flat, equal, striæ fine.................. robustus.
  Thoracic smooth lines equal, parallel entire, strongly elevated.
    Elytral intervals alternately sub-costiform..............costipennis.
Third interval strongly elevated at basal half, striæ coarsely punctate.
  Rostrum normal at tip, median thoracic smooth space dilated in rhomboid at middle .... cariosus.
  Rostrum suddenly dilated at tip and obliquely truncate, median thoracic line entire and not dilated.............. latinasus.

S. pertinax Oliv. V., 83, p. 90, pl. 28, fig. 417; Gyll. Schönh. Gen. Curc. IV., p. 938; Say. Am. Ent. edit. Lec. I., p. 288; *interstitialis*, *truncatus* Say. loc. cit; ? *canaliculatus* Boh. Sch. Gen. Curc. VIII. 2, p. 253.

This species is extremely variable in form and sculpture, but does not admit of further division than merely into varieties, which pass from one to another through every conceivable grade. The following is the description of the typical form.

Black, moderately shining beneath, sub-opaque above. Rostrum three-fourths the length of thorax, moderately compressed, scarcely broader at tip, surface very minutely, at base more evidently punctulate and above at base, with a slight channel, slightly broader and deeper posteriorly. Thorax longer than wide, apex constricted, base feebly bisinuate, sides strongly arcuate in front, sub-parallel at basal half; surface with three entire elevated smooth lines, the middle nearly entire, beginning at apex in a moderately fine line, rapidly widening; at a point in front of middle suddenly narrowed, and from thence to apex continued by a line broadest in front, gradually narrowing to base, and at tip confused by the basal punctures; lateral vittæ entire, beginning at the apical constriction and ending at the basal margin, inner edge sinuous opposite the dilatation of the median vitta, at which point a lateral branch is given off, usually slender and attaining the basal angle, the portion of the lateral vitta posterior to this branch is always broader; space between the vittæ and to the sides, coarsely punctured and more or less filled with luteous coating. Scutellum not sulcate. Elytra at base conjointly feebly emarginate, broader at humeri and arcuately narrower towards apex, which is feebly rounded or subtruncate, surface striate, striæ inconspicuously punctate, intervals feebly alternating in width and convexity, the broader and more convex denuded, the others with luteous coating, surface (when denuded) very minutely punctulate. Pygidium sparsely and rather coarsely punctured, near apex sparsely clothed with short bristly hairs forming a tuft on each side of apex. Body beneath coarsely but sparsely punctate at the sides, at middle comparatively smooth. Legs black, finely punctulate. Length .48–.56 inch ; 12–14 mm.

Var. *interstitialis* Say. Form more robust. Thoracic vittæ scarcely elevated, the median gradually broader to middle, then gradually tapering to base, forming an elongate fusiform space, the intervals between the vittæ more densely punctured. Striæ of elytra distinctly punctured, intervals feebly alternating in width but scarcely in convexity, the broader biseriately, the narrower uniseriately punctured. Body beneath very coarsely punctured, the middle as coarsely punctured as the sides. Length .48–.56 inch ; 12–14 mm.

The punctures of the elytral striæ being more evident in this variety than in any other, together with the slight alternation of the intervals, gives the aspect of a double series of punctures of which Say speaks.

Occurs in the Southern States, and is injurious to the corn.

Var. *pertinax* Oliv. ; *truncatus* Say, is the form described as typical.

Occurs from the Middle States north and west.

Var. ——— ; *pertinax* ‡ Say. Thoracic vittæ less prominent than in *pertinax* Oliv. Elytral intervals sub-equal in width and convexity, and very minutely obsoletely punctulate ; striæ scarcely punctured.

Var. ———; the narrower intervals of the elytra are slightly irregular or eroded, so that an aspect of catenulation is produced.

Occurs in California.

Many other varieties might be enumerated, but these are deemed sufficient to cover the entire ground, so that any form differing from the typical descriptions may not be considered specifically distinct.

Occurs from Canada to Louisiana and from the Atlantic to the Pacific, and, unfortunately for farmers, not rare.

S. robustus n. sp.

Closely allied to *pertinax*, and differs as follows :

Median thoracic vitta feebly dilated at middle, posterior portion broad and attaining the base, lateral vittæ slightly sinuous internally, gradually wider from apex to base, lateral branch feeble. Elytra finely striate, outer three striæ distinctly, inner obsoletely and distantly punctured, intervals flat, sub-equal, alternately bi- and uni-seriately finely punctulate; surface evenly clothed with ochreous or plumbeous sub-sericeous exudation. Length .48–.56 inch ; 12–14 mm.

After the numerous variations of the preceding species which have been mentioned, it is with considerable diffidence that I venture to name the present form, but the aspect of the species is so distinct from that seen in any of the varieties of the preceding, and moreover I find no intermediate forms.

Occurs as widely as the preceding, but less common. A variety of this form occurs with the thoracic vittæ almost entirely obliterated, the punctuation finer, and the elytra glabrous.

S. costipennis n. sp.

Black, shining, form similar to *pertinax* but more slender. Rostrum three-fourths as long as the thorax, strongly compressed and slightly broader at tip, at base slightly canaliculate and moderately punctured. Thorax with three rather strongly elevated entire parallel vittæ, the lateral with a branch from middle to basal angle, intervals coarsely punctured and with luteous coating. Elytra finely striate, striæ with distant, moderately coarse punctures, intervals alternately slightly broader, the broader intervals strongly convex, in their entire length minutely and irregularly biseriately punctate, narrower intervals usually with luteous coating, uniseriately punctate. Pygidium sparsely punctate, punctures near apex submuricate and bearing a short hair, a tuft of hair on each side of apex. Body beneath sparsely punctate. Length .40 inch ; 10 mm.

A variety occurs with the upper surface red, with the sutural interval and the median thoracic vitta black. The under surface is red varied with black, and the legs also red with the knees black.

Georgia, Illinois. Wisconsin, Nevada.

S. cariosus Oliv. Ent. V. 83, p. 91, pl. 28, fig. 415 ; *larvalis* Germ. Ins. Spec. nov. p. 301; *cicatricosus* Say Curc. p. 22; Am. Ent. edit. Lec. I., p. 280 ; *flexuosus* Gyll. Schönh. Gen. Curc. IV., p. 940.

Black, shining, usually more attenuate behind. Rostrum nearly as long as thorax, moderately compressed, sparsely and at base more coarsely punctate, above slightly grooved at base, groove broader and deeper behind. Thorax broader than long, apex moderately constricted, gradually wider, ♂, rapidly broader ♀, and sub-parallel to base, the latter feebly bisinuate ; surface with three vittæ, the median attaining the apical margin, rapidly dilating to a rhomboid form, and very rarely prolonged by a very fine line to base, but usually ending abruptly at middle ; latteral vittæ sinuous, slightly broader at basal end, and emitting a lateral branch from the middle towards the basal angle, a small smooth callus near the anterior portion of the sides ; spaces between, and to the sides of the vittæ coarsely punctured and clothed with a feeble luteous coating. Scutellum longitudinally broadly grooved. Elytra conjointly emarginate, broader behind the base and arcuately narrowing to apex ; surface finely striate, striæ with rather deeply impressed, coarse, distant punctures, each surrounded with a luteous area, intervals flat, slightly irregular, third strongly elevated, cariniform at basal half, and with the humeral callus smooth, shining. Pygidium coarsely punctured, with short setæ along the middle and a tuft of hairs on each side of apex. Body beneath black, shining, coarsely punctured, mesosternum at sides coarsely foveate. Length .32–.44 inch ; 8–11 mm.

This species is one of the most readily recognized species in our fauna. Occurs in the Middle States, rarely ; Gulf States, abundantly.

S. latinasus, n. sp.

Moderately elongate, black, shining. Rostrum slightly longer than half the thorax, moderately compressed, rather suddenly dilated at apex, sparsely punctured, base rather suddenly dilated, above channelled. Thorax longer than wide, constricted in front, rather rapidly dilated to apical third, thence sub-parallel to base, above with three elevated, polished, entire vittæ, the median broadest at apex, then slightly narrower and elongate fusiform to base, lateral vittæ parallel, with a lateral branch toward the basal angle. Scutellum very feebly grooved. Elytra similar in form to *cariosus*, surface finely striate, striæ moderately coarsely punctured, punctures of the striæ opposite, regularly placed, intervals flat, sutural interval shining, sparsely punctulate, third cariniform for half its length and with the humeral callus smooth, the other intervals clothed with luteous coating. Pygidium scarcely narrower to apex, sub-quadrate coarsely punctured, with short setæ and a short tuft of hairs on each side of apex. Body beneath coarsely and sparsely punctured. Length .40 inch; 10 mm.

This species appears to combine the thoracic sculpture of *costipennis* with the elytral sculpture of *cariosus*, but differs from any species known to me by the curious form of the tip of the rostrum. The rostrum is rather suddenly dilated at tip and apparently slightly obliquely truncate, so that when the rostrum is examined at its end, there is seen above the mandibles an oval space, so that the parts of the mouth are more inferior than usual. The third joint of the hind tarsi is fully as dilated as those of the middle and anterior, and is also spongy pubescent at the sides, so that in this respect it has the character of the preceding group, and would have been placed there except that it lacks the glabrous natural coating, and the lateral vittæ have the external branch.

One specimen, Georgia.

Group V.

The third joint of all the tarsi in this group is of a sub-conical form, scarcely at all flattened, and beneath sparsely fimbriate at the antero-lateral margin.

The species are exceedingly troublesome to define, and tabulate in a satisfactory manner.

A. Rostrum arcuate, usually slender. Tibiæ simple.
Thorax more or less distinctly vittate. 1.
Thorax punctured nearly equally over the entire surface, rarely with a smooth, median, not elevated line or space, but never with any traces of lateral vittæ. 2.
1. Median vitta *entire in front*. 3.
Median vitta *bifurcate in front*, enclosing a slight fovea immediately behind the apical constriction. 4.

[illegible] Median vitta more or less dilated at middle.

Median vitta broadly dilated at middle.

Surface glabrous.

First tibiæ ♀ simple. .... [illegible]

First tibiæ ♀ subangulate with dense brush of long hairs. .... scopari

Surface densely covered with an argillaceous coating.

Third elytral interval sub-carinate at basal half .... callos

Elytral intervals flat .... sculptil

Median vitta reduced to a slender apical carina, slightly dilated at the middle of thorax. Surface with argillaceous coating ....melanocephal

Median vitta fusiform, entire, lateral vittæ short, represented by an oblique basal line on each side of base........................ Say

4. Lateral thoracic stripe reduced to short oblique lines at base.. placid

5. Elytra rather deeply striate, striæ scarcely punctured, intervals coarsely, moderately punctured. Thorax coarsely, sub-confluently punctured, and with fine, smooth median line; femora sparsely punctate.... gentil

Elytra moderately finely striate, striæ more coarsely punctured than the intervals and usually foveato-punctate.

Femora very coarsely foveato-punctate, with argillaceous coating................................. parvulu

Femora sparsely punctate, glabrous.

Thorax very coarsely punctate, a median fusiform impunctured space. Thorax large............ retusu

Thorax not coarsely punctate.

Thorax sub-opaque, evenly punctate, elytra feebly attenuate behind......................... arizonensis

Thorax shining, unevenly punctate, elytra strongly narrowed at tip.......................... gagatinus.

B. Rostrum not arcuate, rather short, very strongly compressed. Anterior tibiæ at least very strongly toothed, or angulate at middle.

Anterior tibiæ without sub-apical mucro, median tooth strong.

Rostrum beneath with a laminiform carina terminating abruptly near the base. Thorax beneath coarsely punctate, opaque..................... cultellatus.

Rostrum beneath not carinate, lower edge obtuse.

Thorax beneath sparsely punctate, shining.....compressirostris.

Anterior tibiæ strongly angulate at middle, sub-apical mucro moderately long......................... Germari.

The last three species need no special comment, their characters being abundantly sufficient to distinguish them from any in the genus. The species in Section A are arranged as nearly as may be in such a sequence that the gradual obliteration of the thoracic vittæ may be shown. *S. zeæ* imitates the markings of *cicatricosus* of the preceding group, but the vittæ are much less elevated; *scoparius* is also similar, but the markings still more reduced. The next three species are always densely clothed with the argillaceous indument which almost entirely obliterates all sculpture. *S. callosus* has the thoracic punctures very large, being really erosions which are more or less confluent; *sculptilis* is punctured and not eroded, and has the elytral intervals flat. *S. melanocephalus* may readily be known by the median vitta being reduced to a narrow carina slightly dilated at tip, and which is situated at the anterior half of the median line, and on each side of which is a small callus. *S. Sayi* has the median vitta feeble but entire, and differs but slightly from the next species. The specific name *placidus* is chosen for an abundant and very variable form which has received many names, as it is the name by which it has come to be known to most of our entomologists. It may at all times be known by the median vitta of the thorax being bifurcate in front and between the two branches, immediately behind the apical constriction is a shallow fossa more or less marked, in which the punctures are denser and deeper. Among the species without the usual thoracic vittæ, *gentilis* is known by the deep elytral striæ which are as wide at bottom as at top, punctures not very evident, thorax coarsely and densely punctured, median fine line smooth; *parvulus* recalls *placidus*, and has the femora very coarsely foveato-punctate; *retusus* is a robust form with indistinctly defined, fusiform, impunctured thoracic space; *arizonensis* has the thorax comparatively finely punctured and all the elytral sculpture neatly defined; *gagatinus* is more attenuate posteriorly than any of the preceding, and the thorax shining with the punctures unevenly distributed.

S. zeæ Walsh, Practical Entomologist, II., p. 117; Riley, Third Annual Report, 1871, p. 59, fig 22.

Black, shining. Rostrum three-fourths the length of thorax, slender, slightly compressed, finely, at base more coarsely punctured, not canaliculate, and with a moderate puncture between the eyes. Thorax longer than wide, anteriorly constricted, sides gradually arcuate in front, at middle sub-parallel, base slightly narrower; surface with three elevated vittæ, as follows: median entire, very slender at each end, broadly dilated in front of middle, lateral vitta sinuous, interrupted opposite the broad portion of the median vitta, and with an oblique broad branch from the posterior portion extending toward the basal angle; spaces between the vittæ very coarsely, sub-confluently punctured. Scutellum slightly concave. Elytra oval, emarginate at base, surface finely striate, and with large foveæ rather irregularly placed along the striæ, becoming reduced to punctures toward the apex; intervals flat, very nearly equal, uni-seriately punctured, a slight callosity at humerus and tip of seventh interval. Pygidium coarsely but sparsely punctured, with an oblique line of short yellowish hairs on each side. Body beneath very coarsely and densely punctured. Length .30-.36 inch ; 7.5-9 mm.

The tibiæ of both sexes are simple.

Occurs in Middle States, Georgia and Kansas.

S. scoparius, n. sp.

Agrees with the preceding in form, and differs as follows:

Thoracic vittæ, sub-obsolete, sparsely punctulate, intervals coarsely punctured. Elytra finely striate and with coarse foveate punctures becoming finer toward apex, intervals slightly alternating the wider bi-seriately, the narrower uni-seriately punctulate. Pygidium coarsely punctured, and with a slight tuft of hairs at apex on each side. Body beneath coarsely punctured. Length .36 inch ; 9 mm.

Male. Hind tibiæ stout, strongly angulate at middle of inner margin, and with a long dense brush of hairs at angulation and less densely pubescent from thence to apex.

Female. Tibiæ normal.

Two specimens, Wisconsin and Kansas.

Resembles also superficially some of the smaller varieties of *S. pertinax*, but the tarsal and sexual characters at once serve to distinguish it.

S. callosus Oliv. Ent. V., 83, p. 92, pl. 28, fig. 416 ; Gyll., Schönh., Curc. IV., p. 942.

Black, body above and beneath at sides, densely clothed with brownish argillaceous coating. Rostrum two-thirds the length of thorax, moderately compressed, above punctured, at base sub-canaliculate and more coarsely punctured. Thorax similar in form to that of *zeæ*, base much more distinctly lobed at middle, vittæ very indistinctly limited, their position indicated by very coarse variolate punctures, the median vitta incomplete posteriorly. Scutellum broadly transversely concave. Elytra oval gradually narrowed to apex, base feebly emarginate ; surface irregular, finely striate, striæ coarsely foveato-punctate, third interval at base obtusely elevated, callus at tip of seventh interval moderately elevated. Pygidium coarsely punctured, apex on each side with slight tuft of hairs. Body beneath coarsely but very sparsely foveato-punctate. Length .48 inch ; 12 mm.

This species resembles a *cicatricosus* which has become coated with mud, but the well-marked thoracic vittæ and the absence of variolate punctures in the latter at once distinguish it.

Occurs in the Gulf and Western States.

S. sculptilis Uhler. Proc. Acad., 1855, p. 416.

Body black, above entirely covered with dense argillaceous coating ochreous or pale brownish in color. Rostrum naked at tip, coated at base, two-thirds the length of thorax, sparsely and at base more densely and coarsely punctured. Thorax similar in form to *zeæ*, densely coated and with the vittæ moderately well marked ; median broadly dilated at middle, separated from the lateral by a sinuous row of very coarse punctures, lateral vittæ very broad at base and with an oblique branch. Scutellum shining broadly concave. Elytra oval, moderately narrowed to tip, surface finely striate, striæ with very coarse punctures distantly placed, forming irregular transverse series, intervals sub-equal, surface irregular and evidently punctate, sub-apical callus feeble. Pygidium coarsely and sparsely punctured and slightly pubescent at tip. Body beneath glabrous at middle, coated at the sides, coarsely but very sparsely punctate. Legs coated. Length .28–.36 inch ; 7-9 mm.

Closely allied to the preceding species, and has also the base of thorax moderately lobed at middle, it differs especially in its thoracic and elytral sculpture and smaller size.

Middle, Western and Southern States.

S. melanocephalus Fab. Syst. El. II., p. 435 ; Oliv, Ent. V., 83, p. 93, pl. 28, fig. 419 ; *nubilus*, Gyll., Schönh., Gen. Curc., IV., p. 938.

Body black, densely clothed above with pale ochreous or cinereous argillaceous coating. Rostrum two-thirds the length of thorax, compressed, tip slightly dilated, base rather suddenly wider over the insertion of the antennæ, sparsely punctured, at base much more coarsely and deeply. Thorax longer than wide, apex strongly constricted, in front suddenly broader, thence sub-parallel, base moderately lobed at middle, surface sparsely and coarsely punctured, vittæ short, median represented by a short apical carina slightly dilated posteriorly, lateral by an indistinct line ; on each side near the front angles a small round callosity. Scutellum glabrous, slightly concave. Elytra moderately robust, oval, gradually narrowed behind, surface finely striate, striæ with coarse punctures moderately distantly placed, intervals flat slightly alternating, the seventh at tip slightly elevated in callus. Pygidium coarsely and sparsely punctured, a slight tuft of hairs on each side of tip. Body beneath very coarsely but sparsely punctured. Length .30–.38 inch ; 7.5–9.5 mm.

When the surface coating is removed the intervals are seen to be uniseriately punctate.

Occurs from Georgia to Kansas.

S. Sayi Gyll. Schönh., Gen. Curc. IV., p. 943 ; *subcarinatus*, Mann. Bull. Mosc., 1843, II., p. 294 ; Schönh., Gen. Curc. VIII., 2, 255.

Piceous, frequently rufous, shining. Rostrum slender, three-fourths the length of thorax, suddenly dilated over the antennal scrobes, sparsely, at base coarsely and densely punctured, finely canaliculate and between the eyes transversely impressed. Thorax longer than wide, constricted in front, sides anteriorly rapidly broader, thence sub-parallel to base ; above truncate, median vitta slightly abbreviated in front, at middle moderately dilated, thence finely prolonged to base, lateral vittæ sinuous, approximating in front, slender and without lateral process ; surface coarsely punctured, on each side of median vitta variolate. Scutellum feebly longitudinally concave. Elytra elongate oval, slightly narrowed to apex, surface striate, striæ coarsely punctured, punctures gradually finer to tip, intervals nearly equal, feebly convex, sparsely punctulate. Pygdium coarsely and sparsely punctured. Body beneath moderately and sparsely punctate. Length .26–.28 inch ; 6.5–7 mm.

Closely allied to the following species but differs especially in the absence of anterior fovea of thorax, the greater dilatation of the rostrum at base, and the absence of any evident alternation of the intervals.

Specimens are before me from Pennsylvania, Georgia, and Oregon.

S. placidus Say. Curc. N. A., p. 23 ; Am. Ent. edit. Lec. I., p. 290 ; *renatus*, Say, l. c., p. 22 ; l. c., p. 289 ; *rectus*, *immunis*, Say, l. c., p. 22–23 ; l. c., p. 290 ; *confusus*, Gyll., Schönh., Gen. Curc. IV., p. 944 ; *fallax*, Boh., l. c. VIII., 2, p. 256 ; *reticulaticollis*, Boh., l. c., p. 257.

As all of Say's descriptions were published at the same time, I have chosen that under which the species has been most widely distributed. Strictly speaking *venatus* is the first, and on the other hand *immunis* is described in a more recognizable manner than any of the others. The *reticulaticollis*, Boh., is scarcely worthy of being called a variety, and was probably described as distinct because it was Californian.

Black, feebly shining. Rostrum slender, three-fourths as long as the thorax, sparsely punctured and feebly canaliculate at base. Thorax longer than wide, anteriorly moderately constricted, sides moderately arcuate at apical third and sub-parallel to base ; above feebly trivittate, median vitta broadly dilated in front (inclosing an impression which is more coarsely and densely punctured), prolonged to a fine line at basal half ; lateral vittæ sinuate, joining the median in front, rarely with traces of oblique branch ; surface coarsely punctate, variolate on each side of median vitta at base. Scutellum smooth, very feebly concave. Elytra oval, moderately attenuate behind, surface finely striate, striæ coarsely punctured, punctures gradually finer to apex, intervals flat, slightly alternating in width and convexity, the narrower uni-seriately punctulate ; the broader bi-seriately. Pygidium coarsely punctured, at apex sparsely pilose. Body beneath coarsely and moderately closely punctate. Length .24–.40 inch ; 6–10 mm.

This species is very variable. The form above described, is that in which the sculpture is most developed, but many varieties occur, in which the lateral vittæ are reduced to oblique lines at base. The special character present in all the varieties, and which distinguishes the species from all others in our fauna, is the slight fossa at the anterior median portion of the thorax immediately behind the apical constriction.

Specimens occur in every part of our fauna, Pacific and Atlantic.

S. gentilis Lec. Pacif. R. R. Rep., 1857, p. 58.

Piceous or pale castaneous shining. Rostrum slender, three-fourths as long as thorax, sparsely, at base more coarsely punctured and finely canaliculate, and with an impressed point between the eyes. Thorax longer than wide, moderately constricted in front, sides anteriorly moderately arcuate, sub-parallel or feebly arcuate to base; surface coarsely punctured, somewhat more densely in front, and with a fine, smooth median line. Scutellum not canaliculate, elytra oblong, slightly attenuate posteriorly, deeply striate, striæ not distinctly punctured, intervals flat, equal, very finely alutaceous, and with a single row of very coarse sub-quadrate punctures closely placed. Pygidium coarsely and equally punctured, sparsely pubescent at tip. Body beneath black, coarsely and sparsely punctured, legs piceous or rufous. Length .30–.34 inch; 75–8.5 mm.

The color is sometimes piceous, frequently castaneous, and in some specimens the thorax is piceous, and has on each side of the median smooth line a linear rufous space, and a similar space adjacent to the lateral margin.

Occurs in California.

S. parvulus Gyll. Schönh. Gen. Curc. IV., p. 961.

Black, with cinereous coating of argillaceous material. Rostrum three-fourths as long as thorax, sparsely punctate, base dilated over the scrobes, coarsely punctured, and moderately deeply canaliculate. Thorax moderately constricted at apex, sides in front strongly, thence moderately arcuate to base, surface densely and coarsely punctured, rarely with trace of median line, and at base a slight trace of oblique impression on each side of middle. Scutellum not channelled. Elytra oval, moderately narrowed to tip, surface finely striate, striæ with coarse punctures moderately distantly placed, gradually finer to tip, intervals slightly alternating in width and convexity, uni-seriately and rather coarsely punctate. Pygidium coarsely punctate, slightly fimbriate at apex. Body beneath coarsely, but not densely punctured. Legs coarsely punctate. Length .24 inch; 6 mm.

The smallest species in our fauna, easily known by the above characters.

Occurs in Pennsylvania, Georgia and Kansas.

S. pumilus Gyll. Schönh. Gen. Curc. IV., p. 960.

"*Oblongo-ellipticus, parum convexus, niger, opacus, sparsim cinereo-pulverulentus; thorace dense varioloso-punctato, in medio subcarinato; elytris obsolete, remote punctato-striatis; interstitiis planis, vix punctulatis, guttulis cinereis irroratis.*"

Similar to *S. parvulus*, but twice as large.

This species is unknown to me. It is placed next to *parvulus* by Gyllenhal.

S. retusus Gyll, Schönh. Gen. Curc. IV., p. 949.

Body robust, black, sub-opaque. Rostrum half the length of thorax, slightly arcuate, moderately compressed, and gradually broader to tip, sparsely punctulate between the eyes, flattened and deeply canaliculate. Thorax robust, slightly longer than wide, feebly constricted at apex, sides gradually arcuate, base slightly narrower, surface coarsely variolato-punctate with median fusiform smooth space. Scutellum not canaliculate. Elytra oval gradually attenuate to tip, scarcely larger than the thorax and head, surface striate, striæ with very coarse punctures at basal half, rapidly finer to tip, intervals equal, slightly irregular, and indistinctly uni-seriately punctate. Pygidium very feebly exposed, coarsely punctate. Body beneath coarsely but sparsely punctate. Legs finely punctured. Length .32–.40 inch ; 8–10 mm.

Occurs in the Southern States.

S. arizonensis, n. sp.

Black, feebly shining. Rostrum longer than half the thorax, moderately stout, slightly wider at tip, moderately compressed, sparsely punctulate, at base slightly dilated, more distinctly punctate, and finely grooved. Thorax longer than wide, apex moderately constricted, sides in front strongly arcuate, thence feebly arcuate to base, surface sparsely punctate, punctures coarser toward the middle, and denser at base, a faint trace of smooth median line. Scutellum slightly grooved. Elytra oval, arcuately narrowing to tip, surface finely striate, striæ with very coarse punctures in their entire length, intervals flat, equal, finely uni-seriately punctulate. Pygidium moderately strongly elevated along the median line, coarsely sub-muricately punctured, at tip smoother. Body beneath sparsely and finely punctulate, femora very finely punctured. Length .36 inch ; 9 mm.

A species with very neat appearance, easily known by the above characters.

Occurs in Arizona.

S. gagatinus Gyll. Schönh. Gen. Curc. IV., p. 952 ; ? *necydaloides*, Fab. Syst. El. II., p. 435 ; Oliv. Ent. V., 83, p. 94, pl. 28, fig. 420.

I am not quite certain that these two species are synonymous, as the latter is so briefly described as to be very unsatisfactory. The latter is the older name should they prove identical.

Black, shining. Rostrum three-fourths the length of thorax, feebly compressed, scarcely dilated at base, minutely punctulate, at base finely grooved, groove more deeply impressed between the eyes. Thorax longer than wide, anteriorly constricted, sides moderately arcuate from that to base, surface shining, unequally punctured, punctures sparse and fine over the greater part of the surface, coarser and denser along the base and from the latter coarse punctures extend forwards on each side of the median line, and also slightly within the hind angles, punctures coarse at the apical constriction. Scutellum feebly concave. Elytra oval, scarcely larger than the head and thorax, rapidly narrowed to apex, surface striate, striæ moderately deep, and with coarse punctures gradually evanescent toward the apex, intervals flat, equal, finely punctulate. Pygidium narrow, coarsely punctured, at tip slightly pubescent. Body beneath coarsely and closely punctured, femora minutely punctulate. Length .30 inch ; 7.5 mm.

Easily known by the shining thorax and rapidly narrowed elytra.

One specimen from Georgia.

S. cultellatus, n. sp.

Body robust, black, opaque. Rostrum longer than half the thorax, straight, strongly compressed, above acutely carinate, especially near the tip, beneath with acute laminiform carina, terminating opposite the scrobes by an abrupt sinuation, surface above coarsely at base densely punctured and slightly canaliculate. Front coarsely punctured. Thorax robust, longer than wide, anteriorly scarcely constricted, sides moderately arcuate in front and slightly narrowing to base, surface varolato-punctate, median line slightly elevated. Scutellum not grooved. Elytra scarcely longer than head and thorax, oval, arcuately, and feebly narrowed to tip, surface deeply and broadly striate, striæ catenulate, intervals narrower than the striæ, alternately broader, the narrower cariniform, the broader bi-seriately punctulate. Pygidium coarsely, muricately punctate. Body beneath coarsely but sparsely punctured. Anterior tibiæ with strong obtuse spur above the middle, sub-apical mucro wanting, apical slender and longer than usual; middle and hind tibiæ with the spur sub-median. Length .30–.34 inch; 7.5–8.5 mm.

The femora are very robust, the under side of thorax coarsely punctured. The form of rostrum will easily distinguish the species.

Occurs in Kansas and Texas.

S. compressirostris Say. Journ. Acad., 1823, III., p. 319; Am. Ent. edit. Lec. I., p. 20; *cultrirostris*, Gyll. Schöh. Gen. Curc. IV., p. 951.

Black, feebly shining. Rostrum longer than half the thorax, straight, strongly compressed, above acutely carinate, especially at tip, moderately coarsely punctured, base dilated and with a strong puncture between the eyes. Thorax longer than wide, apex moderately constricted, sides moderately strongly arcuate to base, surface irregularly punctured, at middle sparsely, coarsely variolato-punctate at the sides and on a line each side of middle converging at base. Scutellum moderately convex. Elytra oval, gradually narrowed to apex, surface striate, striæ not deep, coarsely and rather distantly punctured in their entire length; intervals equal, at middle more elevated and uni-seriately punctulate. Pygidium cribrate. Body beneath with prothorax and middle nearly smooth, sides and last ventral segment coarsely punctured. Anterior tibiæ with strong median oblique tooth, middle and hind tibiæ less strongly toothed, tooth sub-median. Length .28–.34 inch; 7–8.5 mm.

Say and Germar used the name *compressirostris* for two distinct species at nearly the same time, and it is difficult to decide, if date of publication is considered, which should be suppressed. I follow the catalogue of Gemminger and Harold, although they incorrectly place the two names as equivalent. Gyllenhal's *cultrirostris* is, however, a synonym under any circumstances.

Occurs from Kansas to Texas.

S. Germari Horn; *compressirostris* ‡ Germ. Ins. Spec. Nov. p. 300, 1824; Boh. Schön. Gen. Curc. VIII., 2, p. 258.

Black, sub-opaque, form robust. Rostrum three-fourths the length of thorax, strongly compressed, very slightly arcuate, upper edge not carinate, base moderately dilated, very coarsely punctured, and concave between the eyes. Thorax longer than wide, anteriorly moderately constricted, sides in front strongly, thence gradually arcuate to base, surface coarsely variolato-punctate, with large eroded spaces. Scutellum with faint median line. Elytra robust, oval, moderately attenuate to tip, surface striate, striæ not punctured, intervals alternating in width, bi- and uni-seriately coarsely punctate and with large shallow foveæ very irregularly disposed over the entire surface. Pygidium cribrate. Body beneath coarsely variolato-punctate. Anterior tibiæ strongly angulate at middle, sub-apical mucro distinct, middle tibiæ subangulate below the middle, hind tibiæ slightly sinuous. Length .38–.40 inch; 9.5–10 mm.

This species forms a link between the sections A and B, by the anterior tibiæ being only angulate and the sub-apical mucro present on all the tibiæ.

Occurs in Kansas and Texas.

CALANDRA Clairv.

Sitophilus Schönh.

Metasternal side pieces narrow, mesosternal epimera ascending, acute above. Anterior coxæ widely distant.

Two species occur in our fauna.

Surface opaque, thorax very densely punctured...... oryzæ.
Surface feebly shining, thorax sparsely punctured.... remotepunctatus.

C. oryzæ Linn. Amoen. Ac. VI., 1763, p. 395; Oliv. Ent. V. 83, p. 97, pl. 7, fig. 81 *a*, *b*; Schönh. Gen. Curc. IV., p. 981.

Color variable from ferruginous to piceous, elytra frequently with four rufous spots, surface opaque. Rostrum slender cylindrical, three-fourths as long as the thorax, at base slightly dilated, surface above with moderately coarse punctures arranged in four series and with a slight fossa between the eyes. Thorax longer than wide, anteriorly constricted, sides feebly arcuate and gradually divergent to base, surface densely and coarsely punctured, punctures with very short setæ. Elytra oblong, slightly narrowed at tip, surface deeply striate, striæ very coarsely and closely punctured, intervals slightly convex, narrow, the sutural with a row of coarse punctures, punctures with very short setæ. Pygidium rugosely cribrate and with short setæ. Body beneath very densely and coarsely punctured. Legs coarsely punctured and with short setæ. Length .12–.14 inch; 3–3.5 mm.

This species occurs in every portion of our fauna, and, in fact, of the world, and is only too well known.

C. remotepunctatus Gyll. Schönh. Gen. Curc. IV., p. 979.

Piceous, moderately shining, similar in form to the preceding, but more convex, thorax sparsely punctate, punctures coarse and on the disc more or less fusiform. Elytra deeply striate, striæ punctured at bottom, not serrate, intervals subequal convex, the sutural with a row of elongate punctures. Pygidum coarsely cribrate. Body beneath coarsely but less densely punctured than *oryzæ*. Length .12–.14 inch; 3–3.5 mm.

In well preserved specimens the surface has fine, short setæ as in the preceding, but they are much more apt to be lost.

Occurs from Canada to Arizona.

Other species of Calandra have been from time to time introduced into our country by ships from tropical ports, although none have found permanent lodgment, as far as I am aware.

COSSONIDES.

This tribe as restricted by Lacordaire (Genera vii, 319), appears to be entitled to higher rank than is assigned it by that author, but a discussion of the merits of this view would require a revision of the entire family and is not pertinent to the objects of the present essay.

The groups as established by Lacordaire appear hardly to be of equal value, and some are composed of rather heterogeneous material. The small number of genera represented in our fauna renders it impossible for me to suggest any change in their arrangement that would be at all applicable to the larger number of exotic genera.

Funicle of antennæ 4-jointed, tarsi 5-jointed..........Dryophthorides.
" " " 5-jointed........................Pentarthrides.
" " " 7-rarely 6-jointed.
  Metasternum very short, eyes placed on the rostrum...Lymantides.
  Metasternum elongate, eyes placed normally..........Cossonides.

Dryophthorides.

This group contains in our fauna, but one genus, remarkable for being the only exception in the entire family in which the tarsi are five-jointed.

Dryophthorus, Schönh.

The antennal insertion is nearer the base than the middle; Lacordaire calls it submedian. The mesosternum in our species is not narrow, but much more widely separates the coxæ than the anterior coxæ are separated by the prosternum. Lacordaire says, "*mesosternum étroit*" and "*pattes antérieures assez largement séparées*," and these characters may really exist in *D. lymexylon*, from which the generic description was probably drawn.

D. corticalis Say, Descr. Curc. N. A. p. 24; Am. Ent. edit. Lec. 1, p. 292; Boh. Schönh. Gen. Curc. IV, p. 1089.

Brownish or piceous, opaque. Rostrum longer than half the thorax, sub-cylindrical, slightly dilated at tip, above slightly sulcate at base, surface coarsely punctured. Head coarsely but sparsely punctured. Eyes oval, transverse coarsely granulated, situated at base of rostrum. Thorax longer than wide, strongly constricted in front, sides behind the constriction moderately arcuate, thence sub-parallel to base which is slightly narrower; surface coarsely variolato-punctate. Scutellum invisible. Elytra elongate oval, at base broader than thorax; sides arcuate, feebly converging to apex; surface deeply and broadly striate, striæ coarsely punctured at bottom, intervals narrow, cariniform but obtuse at summit. Body beneath coarsely but sparsely punctured. Suture between the first two abdominal segments deeply impressed. Anterior coxæ moderately distant, middle coxæ nearly three times as widely separated, hind coxæ very distant, closely approximating the margin of the elytra. Inter-coxal process broad, short, truncate in front. Tarsi five jointed. Length .10 inch; 2.5 mm.

The funicle of the antennæ is composed of four joints only, the club rather suddenly formed and oval. This species from the tarsal and antennal characters, is one of the most easily known Rhynchophor in our fauna.

Occurs over our entire fauna east of the Mississippi, under bark.

Dryophthorus bituberculatus Fab. is said by Boheman to occur in California.

PENTARTHRIDES.

This group is characterized by the funicle of the antennæ having five joints. Two genera occur in our fauna which possess otherwise rather diverse characters, one being of the general aspect of *Dryophthorus*, the other of the commoner *Rhyncolus* type.

Eyes small, rounded, very coarsely granulated, situated on the rostrum. Elytra oval........................ Dryotribus.
Eyes moderate, oval, not very coarsely granulated, situated on the head.
  Elytra oval, scape of antennæ long, scrobes encroaching on the eyes beneath........................ Amaurorhinus.
  Elytra cylindrical, scape short, scrobes beneath the eyes posteriorly.................................. Wollastonia.

DRYOTRIBUS, n. g.

Habitus of *Dryophthorus corticalis*. Rostrum moderately elongate, arcuate, slightly flattened, at base constricted. Head suddenly broader than the rostrum, globular. Eyes small, very coarsely granulated, composed of about twenty facets, round, situated at the side of rostrum one-fifth from base. Antennæ inserted midway between the eyes and tip of rostrum, scrobes moderately deep in front, lateral, gradually becoming inferior, not confluent posteriorly and not encroaching upon the eyes. Scape of antennæ elongate, feebly clavate at tip, as long as the remaining joints together; funicle five-jointed, first joint obconical, stouter and longer thon the following, second obconical slightly longer than the third, joints 3–4–5 subequal gradually broader, club oval slightly flattened, pubescent at tip. Thorax longer than wide. Scutellum invisible. Elytra elongate oval, narrowed at base and apex. Anterior coxæ moderately distant, middle nearly twice as widely separated, hind coxæ very distant, intercoxal process short truncate in front. First ventral suture entirely obliterated at middle. Tarsi moderately stout, slightly pubescent beneath, the third joint feebly emarginate. Metasternum moderately long.

The above characters will serve to distinguish this genus from any other hitherto described. It is represented by one species.

D. mimeticus, n. sp.

Brownish or piceous, opaque. Rostrum three-fourths the length of thorax, coarsely variolato-punctate. Thorax one-fourth longer than wide, moderately convex, at anterior fourth constricted, sides moderately arcuate, base as narrow as the constriction, surface densely variolato-punctate. Elytra elongate oval, broader than the thorax, humeri broadly rounded, sides moderately arcuate, at apical third gradually narrower to tip; surface broadly striate, striæ coarsely punctured, intervals narrow, at summit with a series of moderately coarse, submuricate punctures. Body beneath very coarsely but sparsely punctured, legs coarsely punctured, and with a few short yellow hairs. Length .10 inch; 2.5 mm.

This insect closely resembles *Dryophthorus corticalis*, and might readily be mistaken for it on a hasty examination.

Two specimens collected at Key West, Florida, by Mr. Edward Norton.

WOLLASTONIA, n. g.

Head stout, obconical. Eyes round, feebly convex, moderately coarsely granulated. Rostrum slightly longer than the head, robust, sub-cylindrical, not arcuate. Scrobes commencing at middle, deep, rapidly becoming inferior and distant from the eyes posteriorly. Antennæ robust, scape short robust not longer than half the length of the remaining joints; funicle five-jointed, first joint stout, longer than the others, 2–5 sub-equal broader than long; club round, sub-truncate at tip, glabrous, pubescent at tip, composed almost entirely of the first joint. Thorax longer than wide, cylindrical, but slightly narrowed in front. Scutellum small, rounded at tip. Elytra cylindrical very slightly broader than the thorax. Legs short, robust, tarsi nearly as long as the tibiæ, first and second joints slender, subequal third slightly broader but not bilobed, fourth as long as the preceding together, slender. Anterior and middle coxæ feebly separated, hind coxæ distant, intercoxal process short, sub-truncate in front. Metasternum moderately long.

Closely allied to *Pentarthrum*, but differs by the position of the antennal scrobes, and the more narrowly separated anterior and middle coxæ. In the present genus the scrobes pass entirely beneath the eyes, and are distant from their lower edge. In *Pentarthrum* the scrobes attain the eyes.

Dedicated to Mr. T. V. Wollaston, who has increased our knowledge of the Cossonides by his valuable essay on the genera and species of the Canary and adjacent islands.

W. quercicola. (? *Rhyncolus quercicolus* Boh. Schönh. Gen. Curc. VIII., 2, p. 281.)

Black, feebly shining. Rostrum finely punctured at tip, more coarsely, but much less densely at base. Thorax longer than wide, nearly cylindrical, very slightly narrowed in front, surface coarsely but not densely punctured. Elytra cylindrical scarcely wider than the thorax, humeri moderately prominent, surface finely striate at base, striæ much deeper at apex, with very coarse and deep punctures moderately closely placed; intervals feebly convex, uni-seriately punctulate, tip of elytra with margin slightly prolonged and feebly reflexed. Body beneath black, feebly shining, coarsely variolato-punctate. Legs piceous sparsely punctured. Length .12 inch; 3 mm.

South Carolina, Louisiana, Georgia. I quote the synonym with some doubt, although the specific description agrees very well.

AMAURORHINUS Fairm.

A ? nitens, n. sp.

Black, shining. Rostrum half as long as thorax, finely punctured, and with an impressed puncture between the eyes. Thorax as wide as long, oval, base slightly wider than apex, sides moderately arcuate, surface moderately convex, coarsely and regularly, but not densely punctured. Scutellum small, smooth. Elytra oblong, humeri moderately prominent, sides feebly arcuate, slightly broader behind the middle, margin slightly prolonged at tip, and somewhat reflexed, surface finely striate, striæ moderately punctured, intervals (slightly convex at base) flat, finely uniseriately punctured. Body beneath shining, coarsely and sparsely punctured, abdomen more finely punctured. Length .10 inch; 2.5 mm.

I refer this species with doubt to the above genus, as the characters have never been exposed at sufficient length to determine the point definitely. It corresponds with the description as far as it goes. The following characters are added for the present species, that its position may be determined.

Rostrum slightly longer than the head, slightly arcuate. Scrobes deep, beginning at the middle of the rostrum, encroaching on the eyes behind. Eyes oval, slightly transverse, moderately convex, not coarsely granulated. Anterior coxæ very closely approximated, middle moderately distant, hind coxæ distant, intercoxal process short, slightly arcuate in front. Third tarsal joint moderately emarginate.

Occurs abundantly in Florida.

LYMANTIDES.

The distinction between this group and the next is not very well marked in the genus, which we have in our fauna, the only difference being in the short mesosternum of the former, and the longer mesosternum of the Cossonides. *Lymantes* has the eyes placed on the rostrum, and as far as our fauna is concerned, is the point of greatest difference, but *Catolethrus* of the next group has a similar structure.

LYMANTES Schönh.

Head globular, rostrum separated from it by a deep constriction, moderate, robust, subquadrangular, rounded at the angles, arcuate; scrobes commencing a short distance from the tip, oblique, visible only in front. Antennæ anterior, moderately robust, scape gradually clavate, nearly attaining the eyes; funicle seven-jointed; 1–2 elongate, obconic, the former longer, 3–7 transverse, closely placed, increasing gradually in width; mass moderately large, subglobular, compact. Eyes situated on the rostrum, lateral, small, depressed, narrow, obliquely transverse. Thorax oblong quadrate, depressed, suddenly and for a short distance narrowed in front, truncate at apex and base. Scutellum invisible. Elytra moderately convex, gradually declivous behind, narrower at posterior third, not larger at base than thorax and feebly emarginate. Legs moderate, anterior coxæ feebly separated, thighs gradually in mass, the anterior more strongly than the others; tibiæ narrow, a little compressed, slightly arcuate at the extremity, which is mucronate. Tarsi short filiform, fourth joint long, claws slender parallel. Mesosternum narrow, linear. Form oblong, elongate, unequal.

The above description of the genus is copied from Lacordaire as the species is unknown to me in nature.

L. scrobicollis Gyll. Schönh. Gen. Curc. IV., p. 1086.

"Elongatus, angustus, subdepressus, nigropiceus, nitidus, parce cinereosetulosus, antennis pedibusque dilutius ferrugineis; rostro porrecto, seriatim rude punctato; thorace oblongo, disperse varioloso-punctato; elytris remote punctato-striatis, interstitiis angustis, punctulis valde remotis adspersis, setulis parvis cinereis, præsertim versus apicem adspersa. Corpus subtus profunde disperse punctatum, nigro piceum."

Of the size and facies of *Dryophthorus*.

For a time I supposed the insect, which has been described on a previous page as *Dryotribus mimeticus*, to be *Lymantes*, of which it has many of the characters; but their identity cannot be for a moment suspected without admitting inaccuracies on the part of Schönherr and Lacordaire which are almost inconceivable, although the latter author states in the table (Genera, VII., p. 328) of genera that *Lymantes* is eyeless, and on a subsequent page (p. 332) the eyes and their position are carefully described.

COSSONIDES.

Funicle of the antennæ seven jointed. Eyes normally placed. Metasternum at least moderately long.

The above is all that can be said in general of the genera which compose this group. Many of the genera are extremely closely allied, and as but few are known to me in nature, I have been compelled to rely entirely on the books.

Our genera are as follows:

Rostrum always longer than the head.
Elytra narrowed at base and apex, form oval. Anterior coxæ narrowly separated.
Eyes distinct, scape resting at a distance from them.. Elassoptes.
Elytra parallel, cylindrical, or slightly depressed.
Scape of antennæ impinging on the eyes when at rest.
Anterior coxæ distant.............................. Cossonus.
Anterior coxæ very narrowly separated............ Phlœophagus.
Scape resting at a distance from the eyes.
Funicle seven jointed.............................. Rhyncolus.
" six " .... Hexarthrum.
Rostrum shorter than the head and very stout.
Lateral lobes of submentum prominent anteriorly.... Stenoscelis.

Cossonus and Rhyncolus are especially difficult to separate, as the fact of the scape impinging on the eyes when at rest appears to depend in great part to the length of the scape itself, and also on the size of the eyes. Rhyncolus has, however, the rostrum more robust, and in our species not much longer than the head and feebly narrower.

ELASSOPTES, n. g.

Rostrum stout, feebly arcuate. Antennæ median, scape rather slender feebly clavate to tip, funicle seven-jointed, first joint short, stouter than the following, joints 2–7 gradually and very feebly broader, mass oval rather abruptly formed, truncate at apex. Eyes small, oval, flat, coarsely granulated, and distant from the scape when the latter is at rest. Thorax slightly wider than long, sides strongly arcuate, apex and base truncate. Scutellum invisible between the elytra. Elytra convex, oblong oval. Legs moderate, anterior and middle coxæ extremely narrowly separated, hind coxæ moderately distant, intercoxal process rounded in front. Femora feebly clavate, slightly compressed, tibiæ moderately compressed with strong falcate process at outer angle, inner angle with short spine. Tarsi slender, nearly as long as the tibiæ, first joint nearly equal to the fourth and longer than 2 and 3 together, the latter subequal, the third being slightly shorter, not bilobed, fourth slightly longer than the first, and with small claws.

This genus is closely allied to *Lipommata*, Woll., and differs in the presence of eyes, the more slender antennæ and tarsi. Other differences probably exist which might be determined on comparison. The anterior coxæ are more prominent than is usual among our Cossonides.

E. marinus, n. sp.

Form moderately robust, color ferruginous or brownish, shining. Rostrum longer than the head, stout, feebly arcuate, slightly elliptical in transverse section, coarsely and densely punctured at tip, median line smoother, head sparsely punctate. Thorax slightly broader than long, anteriorly narrower, sides rather strongly arcuate, basal angles rounded. Elytra oblong oval, convex, posteriorly rapidly declivous, sides clasping the body, surface with striæ of coarse punctures at base, punctures replaced gradually toward apex by rounded tubercles. Body beneath finely alutaceous and obsoletely sparsely punctate. Length .12 inch ; 3 mm.

This species is totally unlike anything in our fauna, and bears considerable resemblance to the figure of *Mesoxenus Bewickianus*, Woll., Trans. Ent. Soc. Lond., n. s. Vol. V., pl. 19, fig. 6.

Occurs on the sea beach near San Francisco. Specimens have been sent me by Messrs. Edwards and Behrens.

COSSONUS Clairv.

The species of Cossonus may be divided into three groups which may have generic value :

Rostrum dilated at tip. Body more or less depressed........... A.
Rostrum not dilated at tip.
Body linear, strongly depressed. Scape of antennæ barely attaining the eyes. Rostrum porrected..................... B.
Body convex. Scape of antennæ impinging on the eyes when at rest... C.

A.

This group may be considered to represent the typical *Cossonus*. The rostrum is always distinctly dilated at tip, the antennal scorbes deep and the ridge forming their lower boundary always visible from the front. The species all resemble each other very closely and are difficult to separate :

Thorax truncate at base. Antennæ post-median .... Bohemanni.
Thorax bi-sinuate at base. Antennæ median.
Thorax broader than long, sides arcuate, surface very unequally punctured.................................. platalea.
Thorax longer than wide, sides very feebly arcuate or straight.
Base of thorax with slight tuberosity opposite the scutellum.
Basal portion of rostrum longer than the dilated portion.. subareatus.
Basal portion equal to the dilated portion.
Thorax narrower than the elytra, with coarse distant punctures, elytral punctures coarse.
Thorax sub-depressed without concavity......... piniphilus.
Thorax longitudinally convex, median line slightly concave behind.............................. concinnus.
Thorax as wide as the elytra, punctures coarse but not distant, elytral punctures finer, serrate.
Color black, striæ deeper and broader at base.... crenatus.
Color piceous, striæ scarcely deeper and broader at base.................................. corticola.
Thorax with median line at base sub-cariniform.
Basal portion of rostrum scarcely equal to the apical. impressifrons.

C. Bohemanni *platalea*,‡ Boh. Sch. Gen. Curc. IV., p. 998.

"Nigro-piceus, nitidus, glaber, supra deplanatus, antennis, tibiis, tarsisque ferrugineis; rostro capite duplo longiori, tenuiori, apice minus sensim dilatato; thorace latiori subquadrato, antice evidenter coarctato, supra in ipsa basi obsolete bis impresso, dorso remote lateribus crebre punctato; elytris profunde punctato-striatis, interstitiis latioribus majis convexis."

This species is unknown to me in nature. The antennæ are said to be post-median (?) and the sides of the thorax nearly straight, the base of the thorax is also truncate. It is certainly not the species described by Say, as the elytra are distinctly wider than the thorax in the latter. I have copied Boheman's diagnosis with the change of name rendered necessary by the erroneous identification.

C. platalea Say. Descr. Curc. N. A., p. 24; Am. Ent. edit. Lec. 1, p. 292.

Black, shining. Rostrum longer than half the thorax, moderately arcuate, apex quadrangularly dilated, basal portion longer than the apical, cylindrical, slightly compressed, surface sparsely punctured, at base not sulcate. Thorax as wide as long, apex rather suddenly narrowed, base feebly bi-sinuate and on each side of middle slightly impressed, sides strongly and regularly arcuate, surface flattened, unequally punctured, punctures at the sides denser and finer, at middle coarser and more sparsely placed. Elytra broader than the thorax, flattened, striate, striæ coarsely and serrately punctured, intervals flat, very minutely uniseriately punctulate. Body beneath sparsely punctured. Length .24 inch; 6 mm.

This is the only species in our fauna in this group in which the sides of the thorax are regularly arcuate.

Occurs in the Middle States, under bark.

C. subareatus Boh. Schönh., Gen. Curc. VIII., 2, p. 266.

Differs from *platalea* as follows:

Rostrum at base with a distinctly impressed puncture. Thorax longer than wide, apex moderately constricted, sides in front arcuate, at middle parallel; basal angles rounded. Elytra scarcely wider than thorax, striate, striæ coarsely and serrately punctured, intervals convex punctulate as in *platalea*. Body beneath sparsely and rather finely punctured. Length .20 inch; 5 mm.

The sides of the thorax are more densely punctured than the rest of the surface, within this the punctures are fine and much sparser, and along the middle the punctures are coarser and rather deeply impressed, especially near the base. This and the preceding species have the club of the antennæ much more suddenly formed and the funicle more slender than in any of the species which follow.

Occurs from the Middle States to Kansas.

C. piniphilus Boh. Schönh. Gen. Curc. IV, p. 1002; Mann. Bull.

Mosc. 1843, II, p. 295; *scrobiculatus* Lec. Proc. Acad. 1859, p. 285; Col. Kansas, p. 18; ? *californicus* Motsch. Bull. Mosc. 1845, 1, p. 99.

Black, shining. Rostrum scarcely longer than half the thorax, apical portion quadrangularly dilated and longer than the basal portion, surface sparsely punctured, feebly canaliculate. Thorax oblong, narrower in front, sides feebly arcuate and gradually divergent to base, apex truncate, base feebly bi-sinuate and on each side feebly impressed, median line impunctured, surface feebly depressed, coarsely and deeply but sparsely punctured. Elytra slightly wider than the thorax, surface feebly depressed, deeply striate, striæ wider and deeper at base, coarsely punctured, intervals moderately convex, very minutely sparsely punctulate. Body beneath black, shining, sparsely punctured. Length .14–.18 inch; 3.5–4.5 mm.

This species resembles *crenatus*, but may be readily known from all the species which follow, by the punctures of the striæ being coarse and each one distinct, all the others having the punctures finer and very closely placed. I have before me a typical specimen sent by Mannerheim and also the type of *scrobiculatus*, and the only observable difference being in the better developed form of the latter, the former being smaller and piceo-rufous.

Occurs in California and Oregon.

C. concinnus Boh. Schön. Gen. Curc. IV, p. 1006.

Moderately convex, black, shining. Rostrum not as long as half the thorax, quadrangularly dilated at apical portion which is longer than the basal, surface sparsely punctured, base canaliculate, thorax moderately convex, longer than wide, median line slightly depressed, sides moderately strongly arcuate, base feebly bi-sinuate, surface coarsely and deeply punctured over the entire surface and in the basal impressions cribrate. Elytra not wider than the thorax, moderately convex, deeply striate, striæ coarsely and serrately punctured, intervals moderately convex, at apex flatter. Body beneath moderately punctured. Length .18–.22 inch; 4.5–5.5 mm.

Boheman says the antennæ are post-median and the third and fourth abdominal segment smooth, neither of which can I detect. This species may be known by its much more convex thorax than any other in the present group.

Occurs from Canada to Georgia and Missouri.

It is possible that the species so well described by Boheman (and to which the above is equivalent) as *concinnus* is really the true *corticola* Say, but as Say's types are not extant and the description may be construed to fit either the present or the next, I do not deem it advisible to complicate the synonymy by any change based on mere opinion.

C. corticola Say, Curc. N. A., p. 24; Boh. Schön. Gen. Curc. IV. p. 1005.

Piceous, elongate, sub-depressed. Rostrum not as long as half the thorax, moderately punctured, at base an impressed puncture sometimes prolonged into a short groove, at apex feebly dilated, basal portion shorter than the apical. Thorax oblong, feebly constricted at apex, sides in front feebly arcuate, at middle nearly straight and slightly divergent, base slightly narrowed and bi-sinuate, surface depressed at sides moderately closely punctured, disc at centre frequently impunctured, toward the base coarsely punctured. Elytra elongate, parallel, sometimes narrower than the thorax, surface deeply striate, striæ seriately punctured, intervals narrow, at apex flat, finely uni-seriately punctulate, body beneath piceous, shining, coarsely and on the thorax densely punctured. Length .16–.20 inch ; 4–5 mm.

This species has the facies of being the most elongate of the section. The thorax is more sparsely and irregularly punctured, the coarser punctures at base being so arranged as to give the ante-scutellar tuberosity the appearance of being prolonged into a carina. The elytra are also less deeply and broadly striate than in the preceding species.

Occurs more abundantly in the Gulf States.

C. crenatus, n. sp.

Black, shining. Rostrum shorter than half the thorax, moderately coarsely and deeply punctured, at base feebly canaliculate, apex feebly quadrangularly dilated and longer than the basal portion. Thorax oblong, anteriorly feebly constricted, sides in front moderately arcuate, at middle feebly arcuate or nearly straight, at base narrower, base bi-sinuate, surface feebly depressed, coarsely deeply and moderately closely punctured. Elytra not wider than the thorax and twice as long, surface deeply striate, striæ deeper and broader at base, moderately coarsely and serrately punctured, intervals convex, narrow, with a single series of very minute punctures. Body beneath black, shining, coarsely and moderately densely punctured. Legs piceo-rufous. Length .16–.20 inch ; 4–5 mm.

This species resembles *piniphilus*, but the latter has the thorax very evidently narrower than the elytra and the punctures moderately distantly placed.

Occurs in Northern California and Oregon, under pine bark.

C. impressifrons Boh. Schön. Gen. Curc. IV, p. 1001.

Black or piceous, shining. Rostrum scarcely as long as half the thorax, sparsely punctured, apical portion very feebly quadrangularly dilated and distinctly longer than the basal portion, vertex with a deeply impressed, puncture slightly above the eyes. Thorax oblong, narrower in front, sides feebly arcuate from apex to base, the latter slightly narrower, bi-sinuate, surface coarsely punctured, at sides slightly more densely, median line at base distinctly cariniform. Elytra not wider than the thorax, moderately convex, deeply striate, striæ moderately coarsely and serrately punctured, intervals narrower at base, acute, at apex broader and flat, indistinctly uni-seriately punctulate. Body beneath sparsely punctured. Length .12–.14 inch ; 3–3.5 mm.

This species is the smallest of the present section and is readily known by the sub-carinate median line at base.

Pennsylvania (Boheman) and Florida.

B.

This group contains one very small species of elongate form, rufous color, and with the rostrum porrected. The scape of the antennæ barely attains the eyes, the scrobes deep, very gradually becoming inferior and more widely separated than usual in the genus. The anterior coxæ are widely separated.

The unique species is referred with doubt to *Phlœophagus* by Boheman, but the distant anterior coxæ forbids such a reference.

C. pallidus Boh. Schönh, Gen. Curc. VIII., 2, p. 279.

Linear, rufo-testaceous, depressed, shining. Rostrum cylindrical, feebly arcuate, slightly longer than half the thorax, sparsely punctured, and with an impressed point between the eyes. Thorax oblong, sides gradually divergent from apex, base slightly narrower and feebly arcuate, surface depressed, sparsely punctured, punctures finer in front. Elytra slightly wider than the base of thorax, depressed, striate, striæ deeper at apex, moderately punctured, intervals moderately convex, very minutely uni-seriately punctulate. Body beneath sparsely punctured. Length .06 inch ; 1.5 mm.

This is the smallest Cossonide in our fauna, and is probably the smallest Curculionide.

Occurs from the District of Columbia southward.

C.

The rostrum is cylindrical, slightly arcuate. Scape of antennæ impinging on the eyes, scrobes moderately deep, rather widely separated at their termination beneath.

The species of this group appear to approach closely to *Phlœophagus*, from which they differ in the widely separated anterior coxæ. From all the Cossonus which precede, they differ in their more convex form and more robust facies. I can find no character worthy of being made use of to separate the species generically.

Three species form this group, two of small size and a third is the largest in the entire genus in our fauna.

Thorax oblong, sides arcuate.
  Color black, species large (.26 inch).................... subcylindricus.
Thorax wider than long, sides strongly arcuate.
  Color rufo-piceous, species small (.12 inch)........... pinguis.
Thorax conical, sides very feebly arcuate.
  Color piceous, species small (.07 inch)................. dubius.

C. subcylindricus, n. sp.

Black, shining, form subcylindrical. Rostrum slightly longer than half the thorax, very feebly arcuate, terete, surface moderately punctured, finely canaliculate and with an impressed puncture between the eyes. Antennæ stout, slightly post-median, club scarcely broader than the funicle. Thorax longer than wide, apex feebly constricted, sides arcuate, base slightly narrower and feebly bi-sinuate, surface convex, coarsely punctured, median line and an oval space on each side in front of middle smooth. Elytra not wider than the thorax, nearly cylindrical, surface striate, striæ moderately deep, moderately coarsely but not serrately punctured, intervals feebly convex, irregularly bi-seriately punctured, at apex more rugulose. Body beneath moderately punctured. Length .26 inch ; 6.5 mm.

This species is the largest of the tribe in our fauna, and besides the characters above given, differs from every other Cossonus in having the inner angle of the tibiæ spiniform. The male before me has the tibiæ sparsely fimbriate within.

One specimen, Delaware.

C. pinguis, n. sp.

Reddish brown or piceous, feebly shining, form moderately robust. Rostrum longer than half the thorax, cylindrical, feebly arcuate, sparsely punctured, between the eyes an elongate impressed point. Thorax as broad as long, anteriorly moderately constricted, sides strongly arcuate, base slightly narrowed, feebly bi-sinuate and with an obsolete impression in front of the scutellum, surface moderately and evenly punctured. Elytra not wider than the thorax, moderately convex, striæ moderately deep, at base punctured but neither coarsely nor closely, punctures at apex obsolete, intervals moderately convex, indistinctly punctulate. Body beneath sparsely punctured. Anterior tibiæ sinuate within. Length .12 inch ; 3 mm.

The eighth stria is slightly oblique and joins the seventh slightly behind the humerus, the interval between the ninth and marginal striæ is reduced to an extremely narrow carina. The union of the striæ 7–8 is an unusual character in *Cossonus*, but is the usual form in *Rhyncolus*.

Occurs in Georgia and Florida.

C. dubius, n. sp.

Reddish brown, feebly shining. Rostrum as long as half the thorax, slightly broader at tip, sparsely and at base more coarsely punctured. Antennæ median, club oval sub-acute at tip. Thorax slightly longer than wide at base, sides very feebly arcuate and gradually divergent posteriorly, base feebly bi-sinuate, surface moderately convex, coarsely but not densely punctured. Elytra at base slightly wider than the thorax and slightly wider behind, sides straight at apical fourth obliquely narrowed, apex apparently slightly prolonged and obtusely rounded, surface striate, striæ moderately deep and coarsely and sub-seriately punctured, intervals moderately convex, finely uni-seriately punctulate ; outer striæ as in the preceding species. Body beneath coarsely punctured. Length .07 inch ; 1.75 mm.

The third joint of the tarsi is slightly more dilated than the second.

One specimen from Illinois or Missouri.

From the descriptions and remarks on the four last species, it will be seen that each possesses characters more or less at variance with true Cossonus, and it is possible that some might be referred to genera already known, or to new genera. At present I am totally dependant on the books for my knowledge of the Cossonides, and prefer placing these species as at present, until an opportunity is afforded for a direct examination of representatives of genera unknown to me in nature.

PHLŒOPHAGUS Schönh.

Scape of antennæ impinging more or less on the eyes. Rostrum moderately long. Anterior coxæ narrowly separated, prosternum linear. Third tarsal joint moderately dilated and slightly emarginate at tip.

The species representing this genus in our fauna, are closely related in form to the section *Caulotrupis* Woll.

Two species occur.

Body black, thorax densely punctured.
    Elytral striæ deep, coarsely serrately punctured..........apionides.
Body reddish-brown, thorax sparsely punctured.
    Elytral striæ broad, not deep, punctures coarse not serrate. minor.

Ph. apionides, n. sp.

Black, moderately shining, form recalling *Apion*. Rostrum as long as half the thorax, very feebly arcuate, cylindrical, slightly flattened at apex, moderately punctured. Thorax very little longer than wide, very slightly narrowed at apex, sides moderately arcuate, base very feebly bi-sinuate, disc convex, coarsely and closely punctured. Elytra broader than the thorax, sides feebly arcuate, apex slightly prolonged and obtusely rounded, surface convex, deeply and rather broadly striate, striæ as deep at apex as at base, coarsely and serrately punctured, intervals narrower than the striæ, convex and slightly irregular on their summits. Body beneath coarsely and densely punctured. Length .12 inch ; 3 mm.

The aspect of this species is that of an *Apion*. The lateral striæ are entire, and not abbreviated behind the humeral prominence.

One specimen in the cabinet of Mr. H. Ulke, collected in Pennsylvania.

Ph. minor, n. sp.

Reddish-brown or somewhat paler, shining. Rostrum half the length of the thorax, stout, not arcuate, sparsely punctured. Thorax slightly longer than wide, sides moderately arcuate, and gradually broader behind the middle, base narrower and very feebly bi-sinuate, disc convex, coarsely and evenly, but not densely punctured. Elytra wider than the thorax, sides parallel, apex broadly rounded, surface convex, striate, striæ not deep and gradually feebler to apex, coarsely but not serrately punctured, becoming obsolete toward apex, intervals feebly convex, uniseriately punctulate. Body beneath sparsely punctured. Length .08 inch ; 2 mm.

The eighth stria is slightly oblique, and joins the seventh behind the humerus.

Widely distributed but not common, occurs in Pennsylvania, District of Columbia and Nebraska (Ulke).

RHYNCOLUS Germ.

Rostrum slightly longer than the head, robust, not or very feebly arcuate. Antennæ robust, scape unusually short, not impinging on the eyes, joints of funicle transverse, club not very abruptly formed. Anterior coxæ distant.

Our species are all of moderately elongate, sub-cylindrical form, and are distinguished in the following manner :

Anterior coxæ distant, as widely separated as the diameter of the coxal cavity.
  Form linear, body beneath sparsely punctured ; lateral striæ entire.. protractus.
Anterior coxæ not widely separated, prosternum frequently linear.
  Funicle of antennæ very stout, second joint very short, joints 2–7 very transverse.
    Elytra deeply striate, punctures coarse and serrate......oregonensis.
  Funicle moderately stout, second joint at least as long as the third, joints 2–7 moderately transverse ; elytra feebly striate.
    Rostrum slightly flattened, more or less sulcate.
      Species .14 inch ; first two ventral segments very densely and coarsely punctured.................... brunneus.
      Species .10 inch ; first ventral very sparsely punctured, second nearly smooth....................... dorsalis.
    Rostrum convex, not sulcate.
      Species .08–.10 ; first two ventral segments with coarse sparse punctures.................................. angularis.

R. protractus, n. sp.

Form slender elongate, piceous, moderately shining. Rostrum narrower than the head, and slightly longer, surface moderately punctured, feebly convex, not sulcate. Eyes moderately prominent. Funicle of antennæ moderately stout, second joint equal to the third. Thorax slightly longer than wide, narrower in front than behind, sides very feebly arcuate, base slightly narrowed and feebly arcuate, surface moderately convex, sparsely and not coarsely punctured. Elytra broader than the thorax, and more than twice as long, sides parallel, slightly narrowed to apex, surface moderately convex, discal striæ nearly obsolete, lateral striæ more distinct and entire, striæ moderately punctured, discal intervals flat, transversely wrinkled, lateral intervals slightly convex. Body beneath sparsely punctured. Anterior coxæ distant. Legs rufous. Length .10 inch ; 2.5 mm.

Easily known by its more slender form, distant front coxæ and the entire lateral striæ.

Occurs at Fort Tejon, California, under oak bark.

R. oregonensis, n. sp.

Sub-cylindrical, piceous black, feebly shining. Rostrum slightly longer than the head, moderately convex, coarsely punctured with short median smooth space. Eyes moderately prominent. Funicle of antennæ stout, joints short transverse, second joint shorter than the third. Thorax slightly longer than wide, slightly narrower in front, apex feebly constricted, sides feebly arcuate, base slightly narrower and sub-truncate, disc moderately convex, coarsely and evenly but not very closely punctured. Elytra scarcely wider than the thorax, sides parallel, apex obtusely rounded, surface convex, deeply striate, 7 and 8 confluent behind the humerus, striæ coarsely and serrately punctured, intervals narrow moderately convex, at summit slightly crenulate. Body beneath coarsely and moderately densely punctured, first ventral segment at middle densely and moderately finely punctured. Anterior coxæ approximated. Legs rufous. Length .12 inch; 3 mm.

Occurs in Oregon. The second joint of the funicle is so short and difficult to see that I was at first inclined to place the species in *Hexarthrum*.

There are some specimens in the cabinet of Mr. Ulke, collected in North Carolina and District of Columbia, differing in having a slight transverse impression of the rostrum and an obsolete fovea between the eyes. They do not appear to differ otherwise, and I cannot feel warranted in assigning them specific rank.

R. brunneus Mann. Bull., Mosc., 1843, II., p. 295; Schönh., Gen. Curc. VIII., 2, p. 280.

Sub-cylindrical, piceous or black, feebly shining. Rostrum, slightly narrower than the head and scarcely longer, moderately densely punctured, at middle slightly canaliculate and near the tip a feeble triangular impression. Eyes feebly prominent. Second joint of funicle as long as the third. Thorax longer than wide, slightly narrower in front, with a very feeble constriction, sides moderately arcuate, base slightly narrower and sub-truncate, disc moderately convex, coarsely and deeply but not densely punctured. Elytra slightly wider than the thorax, moderately convex, parallel, apex gradually narrowed, surface striate, lateral striæ feebler, 7–8 confluent, striæ coarsely but not serrately punctured, intervals slightly transversely wrinkled, finely and distantly uni-seriately punctulate. Body beneath coarsely punctured, first ventral segment at middle very densely. Legs rufo-piceous. Length .14 inch; 3.5 mm.

I have before me typical specimens from Mannerheim. A Vancouver specimen differs from the above description in having the thorax densely punctured and the sulcus of the rostrum reduced to a slight fovea near the tip.

Occurs at Sitka, Vancouver, Canada, Vermont.

R. dorsalis Lec. Proc. Acad., 1858, p. 81.

Piceous, shining, sub-cylindrical. Rostrum scarcely narrower than the head and not longer, surface moderately convex, not densely punctured, along the middle feebly canaliculate. Eyes feebly prominent. Thorax slightly longer than wide, sides nearly straight, feebly divergent behind, base slightly narrower, sub-truncate, disc moderately convex, not densely and moderately finely punctured. Elytra slightly wider than the thorax, parallel, apex broadly rounded, surface moderately convex feebly striate, striæ with moderately coarse but not serrate punctures, intervals nearly flat, the sutural with a single row of fine punctures. Body beneath sparsely punctured, first abdominal segment very sparsely punctured, second with a fine row of punctures at both margins. Legs rufo-piceous. Length .10 inch; 2.5 mm.

One specimen, San Diego, California.

R. angularis Lec. Proc. Acad., 1858, p. 81.

This species reproduces the preceding in form and sculpture and differs as follow:

Rostrum not canaliculate, near apex a very slight fovea. Elytra slightly more robust, punctures coarser. Body beneath more closely punctured. Length .08–.10 inch; 2–2.5 mm.

Occurs on the Colorado Desert, under willow bark.

R. corticalis Boh. Schönh., Gen. Curc. VIII., 2, p. 284.

"Elongatus sub-depressus, rufo-ferrugineus, nitidus, glaber; antennis pedibusque dilutioribus, oculis nigris; rostro capite nonnihil longiori, valido, parum arcuato; thorace oblongo, anterius angustato, sat crebre evidenter punctulato, dorso obsolete longitudinaliter impresso; elytris mediocriter punctato striatis, interstitiis subconvexis lævibus."

Form and appearance of (*Cossonus*) *pallidus*, but one-half longer.

Carolina. Unknown to me. The longitudinal impression of the thorax is a character unknown to me in any of our species.

HEXARTHRUM Woll.

Funicle of the antennæ with six joints.

H. Ulkei, n. sp.

Piceous, moderately shining, subcylindrical. Rostrum narrower and longer than the head, moderately densely punctured. Eyes flat. Thorax as wide as long, slightly narrower in front, sides feebly arcuate, base slightly narrower and sub-truncate, disc moderately convex, coarsely and sparsely punctured. Elytra slightly wider than the thorax, cylindrical, surface feebly striate, striæ with coarse punctures, closely placed but not serrate, intervals flat, each with a single series of fine punctures. Body beneath coarsely but sparsely punctured. Anterior coxæ closely approximated. Length .10 inch; 2.5 mm.

The antennæ are more slender than in *Rhyncolus*, and reproduce exactly the figure given by Wollaston. Trans. Ent. Soc. Lond. n. s. V., pl. 18, fig. 2.

One specimen, District Columbia (Ulke).

STENOSCELIS Woll.

I refer with doubt the following species to this genus. The rostrum is very short, narrower than the head. Club of antennæ round, flattened slightly. The lateral processes of the submentum are more prominent than usual in the preceding genera, and are distinctly visible from above.

S. brevis Boh. Schön. Gen. Curc. VIII., 2, p. 282.

Robust, cylindrical, brownish or black, feebly shining. Rostrum short, narrower than the head, moderately coarsely and densely punctured. Thorax broader than long, broadly constricted in front, sides feebly arcuate, base slightly narrower, disc convex, coarsely and densely punctured. Elytra cylindrical, parallel, obtusely rounded at apex, surface striate, striæ broad, coarsely and serrately punctured, intervals narrower, feebly convex at summit, uneven and with a series of fine punctures distantly placed. Body beneath coarsely and sparsely punctured. Length .12 inch; 3 mm.

Described by Boheman as *Rhyncolus*. Resembles *Hylastes* in form, and also, from the figure, *Stenoscelis hylastoides* Woll. (Journ. Ent. Vol. I., pl. XI., fig. 1), except that the sides of the thorax are more nearly parallel at middle, and the basal angles rounded.

Occurs from New York to Florida.

To this genus the following probably belongs:

Rhyncolus latinasus Say. Desc. Curc. N. A. p. 30; Am. Ent. edit. Lec. I., p. 299; Boh. Schönh. Gen. Curc. IV., p. 1068.

"Subdepressus, niger, glaber, antennarum clava pedibusque rufo-ferrugineis; rostro brevi latitudine fere capitis, sublineari, thorace oblongo profunde sub-disperse punctato, obsoletissime carinato; elytris rufo-castaneis, confertim punctato striatis, interstitiis angustis, convexis."

Front with slight fovea. Apical margin of thorax slightly elevated at middle. Length .10 inch (Say).

Occurs in Florida. Unknown to me.

———:o:———

ITHYCERUS Schön.

I. noveboracensis Forst. Nov. Spec. Ins. 1771, p. 35; *curculionoides* Herbst, Käfer VII, p. 136, pl. 105, fig 1; Gyll. Schön. Gen. Curc. 1, p. 246: *punctulatus* Fab. Ent. Syst. 1, 2, p. 461; *Schönherri* Kby. Fauna Bor. Am. IV, p. 271.

Male. Abdomen *apparently* with six segments.

The sixth segment is really the pygidium which projects beyond the corresponding ventral segment, its lower margin being thickened and simulating in its construction a true ventral segment. The anal opening may be seen in the suture between it and the fifth ventral. The latter segment is shorter than those which precede and its posterior margin straight. The dorsal segments of the abdomen are eight in number.

Female. Abdomen with five segments.

The terminal ventral segment is longer than either of the two preceding and oval at tip. The dorsum of the abdomen has seven segments only.

Lacordaire (Genera VI, p. 12) mentions the occurrence of six ventral segments in the specimen before him but failed to recognize the nature of the terminal segment, and having probably only males before him failed to recognize its sexual nature. The projection of the pygidium in the manner indicated is by no means rare in its occurrence, and I have seen it in *Balaninus*, *Orchestes* and many *Centorhynchidæ* but in a much less marked degree than we see it in *Ithycerus*. The apparent reduction of the number of the segments by the entire obliteration of a suture, usually the first, has also been noticed.

Ithycerus occurs from Canada to Texas. The southern specimens are less densely pubescent in the spaces between the short lines of white pubescence, so that the latter are more strongly marked by contrast. Its habits have been fully elucidated by Mr. C. V. Riley in the "Third Annual Report on the Noxious, Beneficial and other Insects of Missouri," 1871, p. 57.

OTIDOCEPHALUS Chev.

The peculiar Ant-like form of the species of this genus renders it easily known. All our species except one, have the femora toothed and are known as follows:

Femora toothed.
Thorax cylindrical, not constricted at base.
Elytra densely clothed with white pubescence with four glabrous lines on each.............................. vittatus.
Elytra moderately densely clothed, pubescence in tufts, surface faintly bronzed............................ Ulkei.
Thorax anteriorly broader and more convex, at base constricted.
Femora very strongly toothed ; elytra with moderately coarse punctures........................ .... myrmex.
Femora with a small very acute tooth.
Elytra striate, striæ coarsely punctured ; thorax densely and coarsely punctured.................... scrobicollis.
Elytra with rows of moderately fine punctures.
Thorax sparsely punctured, elytra broadly oval, gibbous .... Chevrolatii.
Thorax smooth, elytra oblong oval, moderately convex.. lævicollis.
Femora not toothed and more slender.
Thorax coarsely, deeply and evenly punctured, hairs white .... perforatus.

O. vittatus n. sp.

Form moderately elongate. Rostrum vertical, nearly cylindrical, slightly broader towards the tip, moderately punctured, at apex sparsely, at base more densely clothed with white pubescence. Head moderately densely punctured, densely clothed with white pubescence except on the occiput. Eyes moderately distant. Thorax cylindrical, one-fourth longer than wide, sides very feebly arcuate, at base scarcely sinuate, convex, moderately coarsely and densely punctured and clothed with white pubescence, median line slightly elevated, smooth and shining. Scutellum densely clothed with white. Elytra broader at base than thorax. oblong, subcylindrical scarcely broader behind, surface densely clothed with white recumbent pubescence (sparsely along the suture) and with four narrow glabrous lines on each elytron, the pubescent spaces moderately densely and finely punctured, the glabrous lines with a row of moderately fine and distant punctures each bearing an erect black hair. Body beneath moderately densely punctured, sparsely pubescent and with a dense narrow line of white pubescence along the side of the body extending to the tip of the abdomen. Legs sparsely pubescent with recumbent hairs with erect hairs intermixed. Length .26–.30 inch ; 6.5–7.5 mm.

Beneath the pubescence the entire body is black and shining. The femora have a minute tooth. Evidently allied to *O. pelliceus* Rosen.

Three specimens from Owen's Valley, California.

O. Ulkei n. sp.

Body black with very faint tinge of bronze. Rostrum vertical, sparsely punctured at tip, obtusely carinate, on each side bisulcate, sulci coarsely punctured and nearly confluent opposite the scrobe, surface sparsely pubescent. Head very coarsely and deeply and moderately densely punctured, sparsely cinereo-pubescent. Thorax cylindrical, at basal third moderately sinuate, surface convex, very coarsely and deeply and sub-confluently punctured on the disc, less densely on the sides, moderately densely pubescent, a narrow line along the middle and sides paler, pubescence arranged in small tufts and composed of dark cinereous and white hairs intermixed and with erect white hairs very sparsely placed, directed anteriorly. Scutellum pubescent with white. Elytra oblong oval, sides slightly compressed, surface with rows of moderate punctures replacing the striæ, two lateral rows striate, intervals sparsely punctured, each puncture with a tuft of recumbent hairs as on the thorax and with short erect white hairs sparsely placed, pubescence along the suture paler. Body beneath and legs black, shining, sparsely punctured and pubescent similarly to the upper surface but paler. Femora with a minute tooth. Length .26 inch ; 6.5 mm.

This species is so distinct from any other in our fauna that it is hardly necessary to add to the above description. The general aspect of the species is that of being moderately densely pubescent. The pubescence arises from the sparse punctures of the intervals and forms fan-like tufts, always recumbent composed of darker cinereous hairs intermixed with a few white ones.

One specimen in the cabinet of Mr. H. Ulke, by whom it was obtained from Lower California.

O. myrmex Hbst. Käfer, VII, p. 56, pl. 99, fig. 7; *myrmecodes* Say, Curc. N. A. p. 15; Ann. Ent. ed. Lec. I, p. 278; *americanus* Chev. Ann. Ent. Soc. N. 1832, p. 105, pl. 3. fig, 3; Gyll. Schön, Gen. Curc. III, p. 366; Rosensch. loc. cit. VII, 2, p. 205.

Body oblong, slightly compressed, black, shining. Rostrum cylindrical, at base moderately punctured, sulcate, two sulci on the upper surface short, basal, between them a slight carina, on each side a longer sulcus extending from opposite the insertion of the antennæ to base. Head very coarsely but sparsely punctured. Thorax obovate, strongly convex, sides arcuate, base narrowed, surface smooth at the sides, coarsely punctured along the middle especially toward the apex and base, and with sparsely placed black, suberect hairs, pointing anteriorly. Scutellum small with white pubescence. Elytra oblong, broader at apical fourth, convex, slightly compressed, humeri slightly oblique, surface shining with rows of moderate punctures replacing the striæ, intervals with a series of finer, distant punctures each bearing a short erect hair. Body beneath black, shining, with a narrow line at the sides of moderately dense cinereous pubescence extending to the tip of the abdomen, pectus smooth, abdomen sparsely punctured. Legs black, sparsely pubescent with cinereous hairs. Femora with a large, triangular, acute tooth, tibiæ slightly broader below the middle. Length .16–.18 inch; 4–4.5 mm.

This species is known in all collections as *scrobicollis*, and while it is undoubtedly the *americanus* it is none the less *myrmex*, and it is remarkable that no author, Say excepted, has recognized this fact. The large tooth of the femora at once fixes this as the insect intended by all the authors above cited.

Occurs from Pennsylvania westward and to Georgia.

O. scrobicollis Boh. Schön. Gen. Curc. VII, 2. p. 205.

Similar in form and appearance to the preceding. Rostrum similar. Head densely and coarsely punctured. Thorax obovate; convex pilose as in *myrmex*, sides arcuate, base strongly narrowed, surface coarsely, deeply and densely punctured on the disc, more sparsely at the sides. Scutellum cinereo-pubescent. Elytra oblong-ovate, strongly convex, striate, striæ moderately coarsely and sub-serrately punctured, intervals slightly convex, with a single row of fine punctures each bearing an erect hair, either cinereous or black. Body beneath black, shining, sparsely punctured and with a cinereo-pubescent line at the sides. Legs sparsely punctured, black, with erect hairs either cinereous or black. Femora with a minute, acute tooth, tibiæ as in *myrmex*. Length .16 inch; 4 mm.

I have seen but one specimen of this species, captured by Dr. John W. Eckfeldt in Delaware County, Pennsylvania. By a casual examination it might be confounded with *myrmex*, but the very densely punctured thorax and small femoral tooth at once distinguish it.

O. Chevrolatii Horn; *myrmecodes* ‖ Chev. Ann. Ent. Soc. Fr. 1832 p. 445.

Black, shining. Rostrum smooth shining, above very slightly canaliculate near the tip, obtusely carinate to base, on each side two coarsely punctured sulci which coalesce opposite the scrobes and continue nearly to tip. Head sparsely and moderately coarsely punctured, between the eyes a deep fovea. Thorax obovate, convex, sides arcuate base narrower, surface very sparsely and moderately coarsely punctured over the entire surface. Scutellum densely cinereo-pubescent. Elytra broadly oval, very convex, humeri obliquely rounded, surface smooth, shining, with rows of moderately fine punctures, the outer two rows striate, intervals flat with a single row of very minute distantly placed punctures each bearing a short erect hair. Body beneath black, shining, sides of pectus with a narrow cinereo-pubescent line. Legs as in the preceding. Femora with a very minute acute tooth. Length .16 inch ; 4 mm.

The sparsely punctured thorax, strongly arched elytra, deeply foveate front and more sparsely pilose surface, at once distinguish this species.

Rare in the Middle States.

This species is not the *myrmecodes* Say as the Catalogus of Gemminger and Harold would seem to indicate. The name given by Chevrolat being preoccupied, it gives me pleasure to dedicate it to the latter author.

O. laevicollis n. sp.

Black, shining. Rostrum sulcate at the sides in front above the scrobes, above not carinate. Front moderately prominent, between the eyes narrow. Head sparsely punctured. Thorax obovate, convex, sides arcuate base narrower, surface smooth shining, impunctured, or with a very few punctures near the apex at the sides. Scutellum cinereo-pubescent. Elytra oblong oval, moderately convex, smooth shining, with rows of fine moderately distant punctures, the outer two rows slightly striate, intervals flat with a single series of very distant, minute piliferous punctures. Body beneath and legs as in the preceding species. Length .16 inch ; 4 mm.

By its comparatively smooth elytra, this species resembles the preceding but differs greatly in the form of that part. The thorax is very smooth above and very sparsely pilose. The rostrum is apparently broader (in a vertical direction) and the sides at base much flatter and the scrobes therefore more oblique. The front between the eyes is narrow and the latter more prominent than usual, and the head therefore more convex than any other species.

One specimen Georgia and two from unknown localities.

O. perforatus n. sp.

Piceous, shining. Rostrum moderately stout, coarsely but irregularly punctured, grooves obsolete, above subcarinate. Eyes moderately prominent. Head coarsely and deeply but sparsely punctured and between the eyes a more distinctly impressed puncture. Thorax obovate, moderately convex, sides moderately arcuate and in front of base slightly sinuate, surface coarsely, very deeply, evenly but not densely punctured over the entire disc and sides, and with a very few short, slender, white, recumbent hairs. Scutellum minute. Elytra elongate oval, broadest at middle, moderately convex and with rows of feeble distantly placed punctures becoming obsolete towards the apex, intervals with very minute distant punctures, each bearing a slender white recumbent hair. Pectus beneath with a cinereo-pubescent line near the elytral edge, surface nearly impunctured, smooth shining. Femora slender mutic. Length .14 inch; 3.5 mm.

The femora of this species are much more slender than is usual and absolutely devoid of any tooth, and the anterior pair merely very feebly sinuate. One of the most distinct species in our fauna.

One specimen in the cabinet of Mr. H. Ulke, collected in Maryland.

I have not been able to determine, with the specimens at my disposal, whether the sexes are distinguished by the presence of the additional dorsal segment in the male. It is however probable that as in the greater number of *Mecorhynques* which I have examined, the males have 8 and the females 7 dorsal ventral segments.

MAGDALIS Germ.

Our species are few in number and represent all the groups into which the genus has been divided. Four species have simple ungues and two of these have unarmed femora, and all have the thorax without anterior serrature or spines.

The sexual characters are remarkable. The males have the dorsum of the abdomen with eight segments, the females have one less. This results from the union of the last two dorsal segments so that the female has apparently a much larger pygidium than the male. The pygidium of the male is short, twice broader than long. The antennæ of the males are inserted near the tip of the rostrum and in the females very slightly in front of the middle, the rostrum in the males being slightly dilated at tip. Both these latter characters suffer an exception in *M. Lecontei*, as in both sexes the rostrum is similar and the antennæ inserted slightly behind the middle. This might constitute a distinct genus.

As far as known our species are as follows :

Claws simple. Thorax in front not serrate.
Femora mutic.
Body black, elytra with very coarse punctures....... perforata.
Body blue, elytra with moderately fine punctures..... cuneiformis.
Femora dentate.
Body blue, thorax widest at base.................... Lecontei.
Body brown, thorax not wider at base than at middle. imbellis.
Claws toothed at base. Thorax serrulate or dentate.
Mesosternum protuberant. Head elongate conical.
Scape of antennæ not attaining the eyes............. barbita.
Mesosternum not protuberant, scape of antennæ passing the eyes.
Body above totally black.
Hind angles of thorax feebly laminiform, disc densely punctured.

Elytra deeply striate, intervals convex.
Tibiæ, tarsi and antennæ pale piceo-testaceous.. olyra.
Tibiæ black, antennæ and tarsi piceous.
Head broadly conical, eyes moderately convex, scutellum densely clothed with white pubescence.................................... gracilis.
Head elongate conical, eyes flat, scutellum feebly pubescent........................... salicis.
Elytra feebly striate, intervals flat................ inconspicua.
Hind angles broadly laminiform, covering the entire base of the elytra, disc sparsely punctured, opaque, pandura.
Body above and beneath ferruginous.................. armicollis.
Body piceous or nearly black, elytra pale ferruginous.. pallida.

The species of this genus have been for the most part described under the generic names *Thamnophilus* and *Magdalinus*.

M. perforata n. sp.

Black shining. *Female.* Rostrum cylindrical arcuate, moderately punctured, median line at base smoother. Antennæ median, piceous, scape attaining the eyes. Head broadly conical, moderately punctured, eyes flat. Thorax longer than wide, sides in front gradually arcuate, posteriorly nearly parallel, not sinuate, base strongly bisinuate, disc moderately coarse and shining, coarsely, densely and deeply cribrato-punctate. Scutellum small, smooth. Elytra gradually wider behind, at basal margin slightly impressed, surface with striæ of large deep quadrate punctures separated by extremely narrow spaces, intervals narrow, uniseriately punctate. Pygidium coarsely and deeply punctate. Body beneath black, coarsely and densely punctured, abdomen more sparsely punctured. Legs black, femora mutic, the anterior femur impressed near the base. Length .20 inch ; 5 mm.

Has somewhat the aspect of a Cossonus. Tarsal claws simple.

Occurs in Georgia.

M. cuneiformis n. sp.

Elongate, cuneiform, surface blue, shining. Rostrum moderately arcuate, sparsely punctured, more densely near the base. Head broadly conical, sparsely punctured, slightly impressed between the eyes. Thorax longer than wide at base, anteriorly broadly but feebly constricted, sides straight divergent, hind angles moderately prominent and (viewed from above) truncate at tip, base deeply bisinuate, surface moderately convex, deeply and densely punctured. Elytra scarcely wider at base than the thorax, sides gradually divergent, at apical third arcuately narrowing, surface moderately convex, base slightly impressed, and with rows of moderate punctures in obsolete striæ, intervals flat, biseriately punctulate. Pygidium black, shining, coarsely punctured. Body beneath blue, shining, moderately coarsely and densely punctured. Legs sparsely punctured, bluish. Femora mutic, the anterior stouter, compressed at base and with a deep oblique impression. Length .28 inch ; 7 mm.

This species resembles the following, but differ in its mutic femora, more slender form and elytral sculpture. The anterior femora are stouter than the others and more decidedly compressed, and with a deep oblique groove near the base forming an equilateral triangle with the suture between the femur and trochanter and the upper edge of the femur, and causing the appearance of there being two trochanters.

One specimen from Nebraska in the cabinet of Mr. H. Ulke.

M. Lecontei, n. sp.

Bluish green, varying to bronze, thorax somewhat darker. Rostrum black, cylindrical, sparsely punctulate, between the eyes slightly impressed. Antennæ slightly post-median. Head oval, eyes moderately prominent. Thorax broader than long, sides moderately arcuate, near the base slightly sinuate, hind angles moderately produced, acute, base bisinuate, disc convex, densely punctured, median line smoother and a slight impression in front of the scutellum. Elytra slightly broader behind, at base slightly impressed, surface with striæ of moderate punctures, intervals flat, finely transversely strigose and a single row of moderate punctures. Pygidium moderately coarsely punctured. Body beneath slightly darker in color than above, sides piceous cinereo-pubescent, surface moderately densely, the abdomen more finely, punctured. Legs black, femora dentate. Length .20–.26 inch ; 5-6.2 mm.

The rostrum of the male is slightly shorter and less arcuate than the female. Tarsal claws simple.

Occurs from Kansas to Oregon and California. I have also a specimen from South Carolina, smaller and more blue than the Western forms, which I cannot at present separate.

M. imbellis Lec. Pacif. R. R. Rep. 1857, App. I, p. 57.

Reddish brown, sub-opaque, metathorax and abdomen piceous. Rostrum sparsely punctured, antennæ slightly ante-median, ferruginous. Head oval densely punctured, eyes moderately prominent. Thorax broader than long, scarcely constricted in front, sides strongly arcuate, at base sinuate, hind angles moderately prominent, base bisinuate, surface moderately convex, very densely and rather coarsely punctured, narrow median line smooth. Elytra slightly broader behind, base feebly impressed, surface deeply striate, striæ coarsely punctured, intervals flat, moderately coarsely rugulose. Pygidium moderately coarsely punctured. Body beneath coarsely sub-obsoletely punctured, abdomen finely and sparsely punctured. Legs reddish brown, femora dentate, tarsal claws simple. Length .20 inch ; 5 mm.

Easily known by its color, simple claws and not denticulate thorax.

One specimen ♀ Oregon.

M. barbita Say. Curc. N. A. 1831, p. 6 ; Am. Ent. ed. Lec. I, p. 265 ; Gyll. Schön. Gen. Curc. III, p. 271.

Black, subopaque. Rostrum nearly as long as head and thorax, sparsely punctured. Antennæ piceous. Head elongate conical, moderately densely punctured, eyes feebly prominent. Thorax longer than wide, anteriorly feebly constricted, sides feebly arcuate, base narrower, at middle broadly arcuate, on each side very slightly sinuate, hind angles not laminiform, disc moderately convex, near the anterior angles a short spine and several serrations, surface densely punctured with median line smoother. Scutellum densely clothed with white pubescence. Elytra slightly broader behind, base scarcely impressed, surface deeply striate, striæ coarsely punctured, intervals convex, transversely wrinkled. Pygidium densely punctured and opaque. Body beneath densely, abdomen more sparsely and finely punctured. Mesosternum protuberant in front. Legs black. Length .14–.24 inch ; 3.5–6 mm.

Male. Rostrum shorter, less arcuate, slightly dilated at tip. Antennæ inserted near the tip of rostrum, scape (♂ ♀) not attaining the eyes.

The males are smaller than the opposite sex. Resembles *olyra* in appearance, but differs in form of head, length of scape and protuberant mesosternum.

Occurs in Canada, Pennsylvania, Georgia, Dakota.

M. olyra Herbst. Käfer. VII, p. 6, pl. 99, fig. 1 ; Boh. Schönh. Gen. Curc. VII, 2, p. 140 ; *brunnipes* Gyll. Schönh. Gen. Curc. III, p. 270.

Closely resembles the preceding. Differs as follows : Hind angles of thorax feebly laminiform. Mesosternum not protuberant. Head very broadly conical. Antennæ, tibiæ and tarsi pale piceo-testaceous. Length .16–.24 inch ; 4–6 mm.

Antennæ inserted as in *barbita*, the scape barely attaining the eyes in ♀ but passing them ♂.

Occurs with the preceding, but rarely in the Southern States.

M. gracilis Lec. Pacif. R. R. Rep. 1857, App. 1, p. 57.

Black, subopaque. Head rather broadly conical, eyes convex. Thorax slightly wider than long, hind angles not prominent, disc densely punctured, punctures shining at bottom. Scutellum densely clothed with white pubescence. Elytra scarcely wider behind, base feebly impressed, deeply striate, striæ coarsely punctured, intervals narrower than the striæ, convex, rather coarsely transversely strigose. Pygidium coarsely granulato-punctate. Body beneath coarsely punctate, abdomen shining, very sparsely and finely punctulate. Antennæ piceous, legs black. Length .14 inch ; 3.5 mm.

The characters otherwise are as in *barbita* without the prominent mesosternum. The head is more conical than in *olyra* without being of the form of *barbita* and *salicis*.

Occurs in California.

M. salicis n. sp.

Differs from *olyra* as follows : Head elongate conical. Thorax more coarsely and equally densely punctured. Scutellum without white pubescence. Antennæ dark piceous or black, tibiæ and tarsi black. Length .12–.16 inch ; 3–4 mm.

The form of the head and the coarser punctuation of the thorax distinguish this species from both those which precede.

Occurs in the Middle States.

M. inconspicua n. sp.

Similar in form to *olyra* but smaller. Head broadly oval. Thorax as broad as long less densely punctured anteriorly. Scutellum small, black. Elytral striæ feebly impressed, punctures moderate, not serrate, intervals flat and finely transversely strigose. Pygidium rufo-piceous, punctato-granulate. Body beneath coarsely but not densely punctured, abdomen more shining, sparsely and finely punctulate. Length .14 inch ; 3.5 mm.

Easily known from every other species with dentate claws by the flat interstices and feebly impressed striæ. The three outer striæ are deeper.

One specimen, Pennsylvania.

M. pandura Say. Curc. N. A. p. 7 ; Am. Ent. ed. Lec. I, p. 265 ; Gyll. Schönh. Gen. Curc. III, p. 268.

Black, opaque. Rostrum sparsely punctulate and finely alutaceous. Head sparsely punctulate, finely alutaceous and slightly grooved between the eyes. Thorax slightly broader than long, anteriorly rather suddenly narrowed, spine and denticulations nearer the middle than the apex, sides feebly arcuate, base not narrower, hind angles laminiform, covering the entire elytral base, surface sparsely and moderately coarsely punctured, intervals opaque, alutaceous. Scutellum black. Elytra moderately robust, moderately deeply striate, striæ coarsely punctured, intervals feebly convex, finely transversely wrinkled. Pygidium coarsely punctato-granulate. Body beneath black, moderately coarsely punctate, abdomen finely alutaceous, subopaque, sparsely punctate. Legs black. Length .10 inch ; 2–5 mm.

Differs from all the species by its small size, more robust form, sparsely punctured thorax and the broadly dilated laminiform hind angles of thorax. The thoracic serrate space is nearer the middle than in any species.

Occurs in Pennsylvania, Georgia, Missouri.

M. armicollis Say. Journ. Acad. III, 1823, p. 312 ; Boh. Schönh. Gen. Curc. VII, 2, p. 141.

Form of *olyra*. Color pale reddish-brown. Head coarsely and densely punctured. Thorax granulato-punctate, serrations feeble, form subquadrate, sides feebly arcuate not sinuate posteriorly, hind angles scarcely prominent. Elytra deeply striate, striæ very coarsely punctured, intervals narrower, feebly convex, granulate at summit. Pygidium granulate. Body beneath, legs and antennæ pale reddish-brown, punctured as in *barbita*. Length .14–.24 inch ; 3.5–6 mm.

Occurs with *barbita*.

M. pallida Say. Curc. N. A. p. 7; Am. Ent. ed. Lec. I, p. 266.

Body beneath and legs piceous or black, elytra luteous or pale reddish-brown. Thorax coarsely and moderately densely punctured, a fine slightly elevated median line, serratures feeble, sides feebly arcuate at base slightly sinuate, hind angles distinct but not very prominent. Elytra parallel, base feebly impressed, sutural interval slightly elevated at base, surface moderately striate, striæ with coarse but not close punctures, intervals feebly convex, finely alutaceous. Pygidium coarsely punctured. Body beneath and legs black, tarsi piceous, body punctured as in *barbita*. Length .12–.16 inch; 3–4 mm.

Easily known by its coloration.

Occurs in New York, Pennsylvania, Illinois.

The species of Magdalis are all more or less pubescent when recently captured, and the pubescence is so easily removed that but few cabinet specimens retain it, therefore no mention has been made of it in the above descriptions.

BALANINUS Germ.

The marked uniformity of vestiture of many of the species renders it extremely difficult to separate them. Fortunately other more prominent characters exist as will be seen in the table given below. As in *Magdalis* the sexes are known by the longer rostrum of the female, which is more slender and less arcuate than in the male. In the latter sex the dorsum of the abdomen has eight segments and in the female seven.

The mandibles of *Balaninus* are incapable of motion laterally, being restricted to a motion in a vertical plane, acting like scissors in which both edges are acute.

In the American Journal of Science and Arts, Vol. XLIV, July, 1867, Dr. Leconte writes as follows, after mentioning the existence in some genera of Coleoptera of corneous exserted ovipositors, "But it was reserved for the Rhynchophora to exhibit a degradation of type, by which a function, peculiarly appropriate to the posterior extremity of the body, is performed by the head; the elongated beak becoming in fact the ovipositor." This appears to me true only so far as the perforation is concerned into which the egg is to be deposited. The beak really perforates the exterior of the acorn or other fruit and the act of oviposition is done by a long ovipositor of slender form and half the length of the body. I have before me a specimen with the ovipositor protuded and an egg seized by its tip.

Our species of *Balaninus* are as follows:

First joint of funicle shorter than the second.
    Each elytron rounded at tip, pygidium in great part visible; .... caryatrypes.
First joint of funicle longer than the second. Elytra subacute at tip, pygidium feebly exposed.

Pygidium ♀ concave at tip and glabrous, the depression surrounded by moderately long silken hairs.......... **quercus.**
Pygidium ♀ convex, punctured, hairy.
  Thorax longer than wide ; tooth of femur small...... **rectus.**
  Thorax wider than long.
    Tooth of hind femur small, free edge sinuate..... **uniformis.**
    Tooth of hind femur large, triangular, free edge straight.
      Body above and beneath sparsely clothed, with hairs scarcely at all scale-like.................. **caryae.**
      Body above moderately densely, beneath very densely clothed, hairs beneath broad, scaly..... **nasicus.**

B. caryatrypes Boh. Schönh. Gen. Curc. VII., 2, 276.

Body dark-brown, densely clothed with ochreous scale like hairs, thorax at middle broadly fuscous, elytra with fuscous spots irregularly, but closely placed. Rostrum at base punctured. Second joint of funic longer than the first. Thorax not longer than wide at middle, apex half the width of base, sides in front rapidly diverging, then arcuate and very slightly narrowed to base ; base on each side very feebly sinuate ; disc convex coarsely and densely punctured, median line smooth, surface clothed with ochreous scale-like hairs with broad space at middle (except fine median pale lines), and sides fuscous. Elytra oval, emarginate at base, apices obtusely rounded, disc anteriorly slightly depressed, surface striate, striæ punctured, intervals flat, densely rugosely punctulate, surface clothed with ochreous scale-like hairs, interspersed with brownish spots. Pygidium densely and coarsely punctured. Body beneath densely clothed with pale yellow silken scales. Legs pale rufo-testaceous, sparsely clothed with silken yellow, short hairs. Femora with a broad triangular tooth, the apex of which is more acute and directed outwards. Length (excluding rostrum) .32-.44 inch ; 8-11 mm.

Male.—Rostrum shorter, not longer than the entire body, gradually arcuate, nearly from the base. Dorsum of abdomen with eight segments. Pygidium with moderately long silken hairs.

Female.—Rostrum often nearly as long as twice the body, straight at basal three-fourths, arcuate at tip. Pygidium scarcely exposed, with short sparse pubescence. Dorsum of abdomen with seven segments.

This is our largest species, said to live on the chestnut. The color of the elytral pubescence is occasionally uniform. The femora near the tip are very deeply sinuate so that I have described them as being strongly toothed, taking the triangular prominence as a tooth, which is, however, suddenly more slender at apex, and directed outwards toward the apex.

Occurs from the Middle States, westward.

B. quercus, n. sp.

Body brownish, clothed with pale-brown scale-like hairs, nearly uniform on the thorax, elytra moderately closely spotted with pale orange rarely confluent into short transverse lines. Thorax one-third wider than long, sides moderately strongly arcuate, surface densely punctured, very sparsely pubescent, slightly denser along the median line. Elytra oval, gradually attenuate to tip, disc moderately convex, striate, striæ punctured, intervals densely, but not roughly punctured, surface moderately densely clothed with pale-brown, with numerous pale-orange spots, sometimes confluent into short fasciæ. Body beneath moderately densely clothed, paler than above. Femora dentate as in *caryatrypes*. Tarsal claws with the basal appendix narrow.

Male.—Rostrum slightly shorter than the body, moderately arcuate. Abdomen with eight segments above, pygidium at tip deeply concave, the concavity smooth, shining and surrounded by an acute rim fimbriate with long hairs.

Female.—Rostrum longer than the body. Abdomen above with seven segments, pygidium fimbriate, convex.

This species is abundantly distinct by the sexual characters.

There are numerous specimens before me reared by Mr. John Akhurst, of Brooklyn, N. Y., and one from Texas, from M. Sallé (No. 65).

B. rectus Say. Curc. N. A., p. 16 ;[*] Am. Ent. edit. Lec. I, p. 279 ; *rectirostris* Gyll. Schönh. Gen. Curc. III., p. 376 ; *Sayi*, Gyll. loc. cit. p. 375.

Form moderately slender, color piceous, clothed with brownish scale-like hairs, elytra with numerous pale-yellow spots, more or less confluent. Thorax longer than wide, more or less conical, sides very feebly arcuate or nearly straight from apex to base, surface moderately convex, densely punctured, median line slightly elevated, smooth, clothed with brownish hairs with a paler line near the side. Elytra oval, rapidly attenuate to base, surface striate, striæ punctured, intervals flat, densely punctured, densely clothed with brownish pubescence, with numerous pale-yellow spots more or less confluent, sometimes forming fasciæ. Body beneath with paler, more silken scales. Femora with rather strong triangular tooth, slightly sinuous on its distal edge. Claws with moderately broad basal lobe. Length .20-.26 inch ; 5-6.5 mm.

Male.—Rostrum shorter than the body, feebly arcuate. Pygidium convex at tip, punctured and pilose.

Female.—Rostrum nearly twice as long as the body, moderately arcuate at tip. Pygidium less pilose.

Occurs in the Middle and Southern States.

B. uniformis Lec. Pacif. R. R. Rep., 1857, p. 57.

Form robust, brownish or piceous, surface moderately densely clothed with scale-like hairs of variable color. Rostrum slender. Thorax wider than long, sides slightly sinuate in front, rather strongly arcuate, base slightly narrowed, surface sparsely pubescent. Elytra oval feebly emarginate at base, surface striate, striæ punctured, intervals moderately rugulose. Length .24–.30 inch ; 6–7.5 mm.

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[*] The descriptions given by Say, are absolutely valueless, consequently the descriptions of Gyllenhal from types sent by Say, must be relied on in determining the species of the latter author. This appears to be the species supposed to be *proboscideus* Fab. by Say. As none of Say's types are extant, the only way out of the difficulty appears to be to accept the descriptions of Gyllenhal, and determine synonymy directly from them.

Male.—Rostrum nearly as long as the body.

Female.—Rostrum longer than the body.

Variety.—Thorax sparsely pubescent, pubescence cinereous; elytra sparsely cinereo-pubescent with indistinct brownish spots intermixed.

Variety.—Pubescence of thorax more dense, ochreous, discal space darker; elytra with ochreous pubescence with darker spots.

Variety.—Pubescence moderately dense, nearly unicolorous, that of the elytra cinereous with slight yellowish tinge.

This species is distinguished rather by negative characters from those which precede and follow. It has an aspect of greater robustness than any species of the genus. The tooth of the former is much smaller, and the free edge is deeply sinuous. From *rectus* it may be at once distinguished by the form of the thorax, from *nasicus* by the form of the elytra and the much more feeble femoral tooth, and from *caryæ* by the tooth of the femur of the latter being very large and triangular, and the tibiæ much more strongly mucronate at tip.

Occurs in Canada, Pennsylvania, Illinois, Texas, Kansas, California and Oregon.

One specimen of the third variety is marked as injuring the Hazel nut

B. caryæ, n. sp.

Brownish, sub-opaque, very sparsely pubescent above and beneath. Thorax wider than long, sides in front slightly sinuate, strongly arcuate, disc moderately convex, densely and coarsely punctured, very sparsely clothed with ochreous pubescence. Elytra oval, moderately emarginate at base, moderately convex, striate, striæ punctured, intervals flat, roughly punctured, sparsely pubescent with ochreous hairs. Body beneath sparsely pubescent with hairs that are feebly scale-like, and paler in color than the upper surface. Length .36 inch ; 9 mm.

Sexual characters as in the preceding species.

The femora are armed with a strong triangular tooth, and the tibiæ at tip more strongly mucronate than in any of our other species. Among all the females of the preceding species the hind tibiæ are more evidently sinuous than in the male. This is especially noticeable in this species.

The specimens before me are from Mr. Akhurst, of Brooklyn, and they are known to infest the Hickory nut.

B. nasicus Say. Curc. N. A., p. 16 ; Am. Ent. edit. Lec. I., p. 279 ; Gyll. Schönh. Gen. Curc. III., p. 377 : *nasutus* ♀ Say, loc. cit. ; *rostratus*, Gyll. loc. cit,, p. 374 ; *sparsus* Gyll. loc. cit., p. 379.

This species resembles a small *carytatrypes*, and differs in having the thorax broader, the sides more arcuate. The surface is similarly clothed, but on the elytra the tendency of the paler pubescence is to form bands. The elytra are triangular, the sides scarcely arcuate and very rapidly narrowing to apex. The femora are armed with a strong triangular tooth, and the tibiæ, especially the posterior, feebly mucronate. Length .24–.30 inch; 6–7.5 mm.

Sexual characters as in *caryatrypes*.

Occurs in Pennsylvania, Illinois, Kansas, Georgia, said to infest acorns and hazel nuts.

Balaninus porrectus Boh. Schönh. Gen. Curc. VII., p. 292.

This does not appear to belong to the genus.

ORCHESTES Illig.

The form of the hind femora will serve to make this genus readily known, as in nearly all the species they are stout, and enable the species to leap after the manner of the Halticides. Their facies is much that of Apion. Our species are few in number, and are distinguished in the following manner:

Funicle of antennæ six-jointed.
  Body above black, inconspicuously grayish-pubescent, legs black, tarsi and antennæ pale, rufo-testaceous.... pallicornis.
Funicle of antennæ seven-jointed.
  Body above black without conspicuous pubescence; scutellum densely clothed with white pubescence..... niger.
  Body above with pubsecence forming a conspicuous design.
    Legs entirely black, pubescence of elytra sparse, antennæ pale rufo-testaceous.......................... subhirtus.
    Legs rufo-testaceous, hind femora piceous, antennæ pale rufo-testaceous, pubescence of elytral design dense and nearly white............................. ephippiatus.

O. pallicornis Say. Curc. N. A., p. 16; Am. Ent. edit. Lec. Vol. I. p. 280.

Oblong oval, black, moderately shining, sparsely clothed with short grayish hairs. Rostrum nearly as long as the head and thorax, subcylindrical, coarsely but sparsely punctured near the tip. Head opaque, finely granulate, and sparsely punctured. Antennæ pale piceo-rufous, club darker, inserted behind the middle of rostrum, funicle six-jointed, first three joints moderately elongate, last three moniliform. Thorax broader than long, sides moderately arcuate, apex narrower, base slightly narrowed, surface sub-opaque, coarsely and rugosely punctured, feebly longitudinally impressed at base. Scutellum black. Elytra oblong oval, at base more than a half broader than the thorax, surface moderately shining, striæ feebly impressed (the sutural and second more distinctly) and with moderately coarse punctures, intervals nearly flat, sparsely punctate. Body beneath black, shining, abdomen moderately coarsely the terminal especially punctured. Legs black, tarsi pale rufo-testaceous. Length .10-.12 inch: 2.5-3 mm.

This species may be readily known by the six-jointed funicle of the antennæ and by the pubescence of the surface sparsely placed, very inconspicuous even with the lens, and without any tendency to form a design. The antennæ vary somewhat in color, but are never black. The tarsi are always pale rufo-testaceous.

Three specimens before me are from Illinois, and another from near Puget Sound.

O. niger n. sp.

Black, sub-opaque, surface clothed with nearly black, recumbent pubescence, elytra with faint pruinose transverse band at one third from base. Rostrum cylindrical, as long as head and thorax, moderately punctured over its entire surface. Antennæ piceous, inserted near the middle of the rostrum. Thorax broader than long, narrower in front, sides moderately arcuate, base slightly narrowed, surface coarsely, deeply, and moderately densely punctured, sparsely clothed with brownish pubescence, with a few cinereous hairs along the middle and sides. Scutellum densely clothed with silvery-white hairs. Elytra moderately robust, slightly longer than wide, one-half wider at base than the thorax; surface moderately deeply striate, striæ coarsely punctured, intervals flat, rugulose, clothed with short, recumbent, brownish pubescence, and an irregular transverse pruinose band near the basal third. Body beneath and legs black, shining, abdomen moderately coarsely punctured. Length .08-.10 inch; 2-2.5 mm.

The conspicuously white scutellum is a notable feature in this species. Occurs in Nova Scotia, Canada, and Illinois.

O. subhirtus, n. sp.

Black, feebly shining, surface moderately clothed with brownish hair, and with grayish hair forming an irregular band near the basal third, broadest at suture, and a narrower band near the apex of irregular form and much narrower than the preceding. Rostrum cylindrical, moderately arcuate, coarsely punctured. Antennæ testaceous, inserted near the middle of the rostrum. Thorax nearly three-fourths wider than long, sides moderately arcuate, apex narrower than base, surface opaque, sparsely rugosely punctured, and very sparsely cinereo-pubescent. Scutellum cinereo-pubescent. Elytra oval, longer than wide, at base one-third broader than the thorax, striate, striæ coarsely punctured, intervals flat, rugulose, surface sparsely clothed with dark brownish pubescence, and with an irregular sub-basal band of cinereous pubescence broadest at the suture, anterior and posterior margins sinuous, and a sub-apical narrower band. Body beneath black, sparsely pubescent, moderately punctured and shining. Legs piceous-black, tarsi pale testaceous. Length .08 inch; 2 mm.

The pubescence clothing the surface is coarser than in the other species in our fauna, and the design formed by the cinereous pubescence is very distinct, much more evident than in *niger*, but much less so than in *ephippiatus*.

Two specimens are before me from Illinois.

O. ephippiatus Say. Curc. N. A., p. 16; Am. Ent. edit. Lec. Vol. I. p. 289.

Piceous, moderately robust. Rostrum rufous, cylindrical, moderately punctured. Antennæ pale rufo-testaceous. Head rugosely punctate, subopaque. Thorax broader than long, apex narrower, sides moderately arcuate, median line slightly impressed, surface rugosely punctured and very sparsely cinereo-pubescent. Scutellum white. Elytra moderately robust, slightly longer than wide, at base one-third wider than the thorax, striate, striæ moderately coarsely punctured, intervals flat, rugulose, clothed with dark brown pubescence and with a large irregular space near the base, and a sub-apical irregular band densely clothed with silvery-white hairs. Body beneath black, shining, sparsely punctured. Legs pale rufous, hind femora piceous. Length .12 inch; 3 mm.

The surface color of the elytra is not entirely piceous, that covered by the white hairs being rufous. The conspicuous character of the design will make this species readily known.

Two specimens are before me, one from Pennsylvania, the other Illinois.

O. puberulus Boh. Eug. Resa, 1859, p. 133. California.

Unknown to me.

The species of *Orchestes*, as far as known to me in our fauna, have the femora unarmed. The larva undergoes its changes in a cocoon, which it prepares in a manner still unknown to science. The same habit has also been noticed by Mr. C. V. Riley in *Prionomerus calceatus* (Say), (carbonarius *Gyll.*), and *Phytonomus comptus* Say, of which full accounts will doubtless soon appear.

RHYSSOMATUS Schönh.

Our species are few in number, and are thus distinguished:

- Body above black, sometimes with obsolete brownish elytral spots.
  - Alternate elytral intervals more elevated; a short humeral carina.
    - Thorax very obliquely strigose, elytra obsoletely maculate .... palmacollis.
    - Thorax longitudinally strigose, elytra entirely black.... lineaticollis.
  - Elytral intervals equal, humeral carina attaining the apex.
    - Thorax feebly obliquely strigose........ æqualis.
- Body above brown, surface sparsely pubescent; humeral carina entire.
  - Thorax obliquely strigose........ pubescens

R. palmacollis Say. Curc. N. A., pp. 16, 27; Am. Ent. edit. Lec., I., pp. 279, 295; Boh. Schönh. Gen. Curc. IV., p. 366.

Form short, robust, oval, black, feebly shining. Rostrum as long as thorax, moderately arcuate, sparsely punctured at tip, at sides feebly sulcato-punctate, above carinate at base. Head densely punctured. Thorax nearly twice as wide at base as long, sides gradually arcuate, apex moderately constricted, base feebly arcuate, disc moderately convex, median line finely carinate, and with deep strigæ, oblique and parallel, surface glabrous. Scutellum densely clothed with brownish pubescence. Elytra oval, gradually and arcuately narrowed to apex, very convex, with rows of deep oblong punctures, suture and each alternate interval acutely carinate and a short carina at humerus, color black obsoletely spotted with brownish especially near the apex, the spots slightly pubescent. Body beneath coarsely, abdomen and legs more finely and densely pubescent, each puncture bearing a very short yellowish hair at bottom. Femora moderately toothed, tibiæ with a tooth near the apex externally. Length .24 inch; 6 mm.

The oblique strigosites of the thorax are nearly at right angles to the sides of the thorax, and the basal line of the thorax is straight and transverse opposite the scutellum.

Occurs in Florida and Texas, not common.

R. lineaticollis Say. Journ. Acad. III., 1823, p. 313; Curc. N. A. and Am. Ent. ut supra; Boh. Schönh. Gen. Curc. VIII., 2, p. 9.

Similar in form and sculpture to the preceding, differing as follows:

Rostrum acutely carinate at basal half, a slight impression slightly above the eyes. Thorax more than twice as wide as long, sides strongly arcuate, apex scarcely constricted, surface with deep strigæ, longitudinal and parallel with the median line, becoming slightly arcuate near the sides. Scutellum glabrous or very nearly so. Elytra entirely black without brownish pubescent spots. Length .22–.26 inch; 5.5–6.5 mm.

The basal line of thorax at middle is slightly arcuate and approaches more nearly the scutellum.

Occurs from Pennsylvania to Kansas and Texas.

R. æqualis n. sp.

Robust, oval, black, feebly shining. Rostrum sparsely punctured in front, basal half punctato-sulcate, not carinate. Head moderately densely punctured. Thorax one-third wider at base than long, sides arcuate, apex feebly constricted at the sides, base feebly arcuate, surface obliquely arcuately strigose, with a few punctures along the apical and basal margins. Scutellum not pubescent. Elytra oval, feebly narrower at apex, surface with rows of coarse deep, elongate punctures, intervals nearly flat, slightly reticulately rugulose, no short humeral carina. Body beneath coarsely, abdomen very densely and more finely punctured. Length .16 inch; 4 mm.

The intervals are not absolutely equal, some are flat the others slightly convex but the difference is not sufficient to be noticed readily, and the intervals being thus equal the short carina at the humerus disappears.

Pennsylvania, Illionis, Kansas.

R. pubescens, n. sp.

Oval, moderately robust, brownish ferruginous, feebly shining, sparsely clothed with yellowish hairs over the entire surface. Rostrum rather slender, sparsely punctured, at sides punctato-sulcate, above not carinate. Head coarsely and very densely punctured. Thorax nearly twice as wide at base as long, sides arcuate, apex moderately constricted, base feebly arcuate, surface moderately convex, median line not carinate, with oblique strigæ closely placed and a few punctures along the apical and basal margins. Scutellum sparsely pubescent. Elytra feebly narrower to the tip, surface with rows of coarse, deep, nearly round punctures not closely placed, intervals alternately carinate, the flat intervals densely punctulate. Body beneath colored as above, coarsely punctured, abdomen more finely and densely, sparsely pubescent. Legs concolorous. Length .22 inch ; 5.5 mm.

This species agrees with the first two in having the intervals alternately cariniform and a short humeral carina, but differs from all our species in the color and the pubescent surface.

Two specimens, Owen's Valley, California.

CHALCODERMUS Schönh.

This genus is so closely allied to *Rhyssomatus* that it becomes a matter of difficulty to separate them when the foreign species are considered. Lacordaire relies on the character afforded by the hind tibia in which the tip or truncature is entirely open in *Rhyssomatus* and closed by a ridge in the present genus.* Our species are few in number and are the more readily known by their more slender rostrum and the absence of any tooth near the apex of the tibiæ on the outer edge.

Our species are as follows :

Elytra striate, intervals elevated.
    Surface ferruginous (with aeneous tinge)............. pruinosus.
Elytra not striate but with rows of coarse punctures.
    Thorax suddenly narrowed in front, coarsely punctured... aeneus.
    Thorax deeply longitudinally strigose ; body brown elytra paler.................................... collaris,
    Thorax irregularly strigose ; body black............. inaequicollis.

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* For a fuller account of this character see Genera dės Coléoptères, Vol. 6, p. 11. The truncatures of the hind tibiæ Lacordaire designates as "*corbeilles*," a technical word having no equivalent in our language, and the difference meant by "*cordeilles caverneuses*" and "*découvertes*" are there fully exposed.

C. pruinosus Boh. Schönh. Gen. Curc. VIII, 2, p. 13.

Oval, convex, ferruginous, moderately shining. Rostrum sparsely punctured in front, at base feebly longitudinally sulcate, above carinate. Head sparsely punctured, eyes moderately separated. Thorax nearly twice as wide at base as long, sides gradually, arcuately wider to base, apex very feebly constricted, base feebly sub-bisinuate, surface moderately convex, median line slightly smoother, coarsely and moderately densely punctured, the punctures tending to strigosity at the sides. Scutellum small, round, glabrous. Elytra oval, arcuately and but feebly narrowed toward apex, surface deeply striate, striæ with coarse punctures, intervals subacutely convex. Body beneath ferruginous, sparsely punctured, abdomen very much smoother. Legs ferruginous, femora dentate, anterior tibiæ with margin sinuous. Length .18–.20 inch ; 4.5–5 mm.

Boheman describes this species as having a slight aeneous tinge to the surface, a character not possessed by any of the three specimens before me. One of the specimens has the intervals of the elytra quite conspicuously punctulate but does not otherwise differ.

Occurs in Arizona and Peninsula of California.

C. æneus Boh. Schönh. Gen. Curc. IV, p. 388.

Black with faint bronze tinge. Rostrum sparsely punctulate, feebly carinate. Head sparsely punctulate, eyes very narrowly separated. Thorax one-fourth wider at base than long, anteriorly rather suddenly narrowed, behind the constriction obtusely subangulate, thence feebly arcuate and scarcely broader to base, the latter decidedly bisinuate, surface convex, sparsely perforato-punctate. Scutellum small, glabrous. Elytra oval, subparallel in front, toward apex arcuately narrowed, convex, with rows of deeply impressed punctures, intervals extremely minutely alutaceous and with a row of fine punctures each bearing a very minute scale. Body beneath black, coarsely punctured, abdomen more sparsely punctured, terminal segment more densely punctured. Legs black, coarsely punctured, femora dentate, anterior tibiæ narrower at basal third. Length .20–.22 inch ; 5–5.5 mm.

Occurs in Georgia and Florida. Easily known by the coarsely perforato punctate thorax.

C. inaequicollis n. sp.

Black with distinct aeneous tinge. Rostrum sparsely punctured at tip, feebly sulcate at sides near base, above obtusely subcarinate. Head sparsely punctured, eyes moderately distant with an impressed puncture between them. Thorax one-fourth wider at base than long, sides in front feebly sinuous and thence feebly arcuate to base, surface shining, median line carinate in front, suddenly wider at middle, on each side a deep sulcus, anteriorly and laterally with deep broad irregular sulci, on each side of median sulci a smooth space. Other characters as in the preceding species. Length .22 inch ; 5.5 mm.

The sides of the thorax beneath are sculptured with deep broad, short grooves, while the preceding species has deep foveate punctures.

One specimen, Georgia.

C. collaris n. sp.

Brownish with aeneous lustre. Rostrum sparsely punctured, sides at base feebly sulcate. Head sparsely punctured, eyes moderately separated, a slight impression between them. Thorax one-third wider at base than long, sides slightly sinuate in front, thence arcuate to base, surface deeply longitudinally strigose, anteriorly slightly punctured. Scutellum small, smooth, aeneous. Elytra ferruginous with aeneous lustre, obsoletely maculate with brownish, sculptured as in the preceding species. Body beneath and legs as in the preceding species. Length .22 inch ; 5.5 mm.

One specimen, Texas, differs in color and thoracic sculpture from any of our species.

ANALCIS Schönh.

In all the species which I have examined, I have been unable to detect any variation in the number of the dorsal abdominal segments between the specimens which I have superficially considered as opposite sexes.

The species divide themselves naturally into two distinct forms, the one opaque and more or less clothed with scales forming bands of variable width, the other shining, æneous, and without any surface vesture The following table shows their further relationship.

Body above black, varying to rufous, surface usually opaque with scale-like vestiture, abdomen punctured.	
Thorax coarsely foveolato-punctate, surface irregular.	
Elytra at base with large pentagonal punctures, at apex the striæ and punctures obsolete....................	morbillosus.
Elytra at base with large round punctures arranged in very regular rows, striæ and punctures at apex distinct.....................................	foveolatus.
Thorax with coarse punctures evenly distributed........	variegatus.
Thorax very densely punctured........................	fragariæ.
Body above æneous, shining, without vestiture, thorax indistinctly punctured, abdomen smooth...............	æreus.

A. morbillosus Lec. Pacif. R. R. Rep. App. 1, p. 58.

Oblong, black, opaque. Rostrum coarsely and densely punctured, at base a slight fovea, surface with distant white scales more dense in the fovea. Thorax longer than wide, moderately convex, sides obliquely narrowed in front, very feebly arcuate to base, the latter slightly lobed, surface moderately convex, with very coarse punctures on each side of middle (which has a smooth space) at the sides less coarse, and with white scales in the punctures. Elytra broader than the thorax, parallel, at apex rounded, convex, surface with rows of very coarse pentagonal punctures becoming rapidly smaller towards the apex where the striæ are rather more evident and the punctures extremely small; vestiture consisting of white elongated scales in the larger punctures and patches arranged as follows:—a small spot on each side of the scutellum, an oblique narrow band from the humerus towards the suture more or less interrupted, a transverse band at two-thirds interrupted at the suture with its anterior and posterior edges of very irregular outline. Body beneath black, opaque, very coarsely punctured. Legs black moderately punctured, each puncture with a short white scale. Length .20 inch; 5 mm.

One specimen, San Francisco.

A. foveolatus Say, Curc. N. A. p. 19; Am. Ent. ed. Lec. I, p. 284; Germ. (*Cryptorhynchus*), Schönh. Gen. Curc. IV, p. 140.

Closely allied to the preceding species and differing as follows: Thorax obliquely narrowed in front and slightly sinuous, sides thence moderately arcuate and at base slightly convergent, surface with large foveæ closely placed on each side of median line so that the latter appears carinate, foveæ at sides smaller, fovea with yellowish white scales and a denser line of scales within the margin approaching the middle in front. Elytra with rows of large, round, deep punctures arranged in regular striæ becoming gradually smaller to apex; vestiture as in the preceding species but consisting of yellowish scales. Length .16–.20 inch; 4–5 mm.

The lateral striæ of the elytra have coarse punctures in their entire length while the preceding species has four or five punctures at base only. It is possible that further specimens will unite the two species.

Occurs from Pennsylvania to Iowa and Georgia.

A. variegatus n. sp.

Oblong, moderately shining, piceous, varying to rufous. Rostrum shining, coarsely and irregularly punctured, at base not foveate. Thorax of nearly oblong oval form, longer than wide, subtruncate at base which is narrower than the thorax at middle, surface moderately convex, with coarse punctures finer at the sides, rather unevenly disposed, vestiture arranged as in the preceding species. Elytra oblong oval, sides moderately arcuate, disc with rows of coarse punctures becoming rapidly finer towards the apex where the striæ become more evident; vestiture arranged as in the preceding species but scarcely scalelike, the surface covered by the pubescence rufous, the naked parts black or piceous. Body beneath black, shining, coarsely and sparsely punctured. Length .14–.18 inch; 3.5–4.5 mm.

The elytra are never in this species as in the preceding, totally black, there being in all the specimens an oblique humeral stripe and the subapical band rufous, these rufous spaces may extend themselves so that the black almost entirely disappears excepting in a small triangular lateral space and the extreme tip. The vestiture is hairy rather than scale-like.

Occurs from Illinois to and throughout the Gulf States.

A. fragariæ Riley. Third Annual Report on the Noxious, Beneficial, and other Insects of the State of Missouri. 1871, p. 42, fig. 14.

Form oblong, rufo-piceous, elytra paler. Rostrum moderately coarsely and densely punctured and with a triangular fovea at base. Thorax as in the preceding species, densely and moderately coarsely punctured, each puncture with a short slender scale. Elytra oblong oval, sides arcuate. wider behind the middle, with rows of moderately coarse punctures which become gradually smaller towards the apex without the striæ becoming more evident; pale rufous very sparsely clothed with short cinerous scale-like pubescence, arranged more densely in two crescentic bands on each elytron, placed slightly obliquely, and behind each band a small fuscous spot. Body beneath rufo-piceous, coarsely punctured, legs paler. Length .16 inch ; 4 mm.

A specimen of this species was sent me by the late B. D. Walsh, bearing the name which Mr. Riley had adopted. It differs from every species known by the dense and even punctuation of the thorax. Injures the Strawberry plant.

Occurs in Illinois and Missouri.

A. æreus Say. Curc. N. A. p. 29; Am. Ent. edit. Lec. I, p. 297; Rosensch. Schönh. Gen. Curc. IV, p. 279.

Black, shining, upper surface with distinct æneous lustre. Rostrum densely and moderately coarsely punctured, at base a fine sulcus, thorax longer than wide, apex rounded, base feebly bisinuate, sides in front obliquely and slightly sinuously narrowed, at basal half nearly straight and parallel; surface convex, punctuation variable but never more than sparsely punctulate. Elytra with rows of moderate punctures at base, apex smooth. Body beneath black, shining coarsely and sparsely punctured, abdomen smooth. Legs black, moderately punctured. Length .12-.16 inch ; 3-4. mm.

The punctuation of the thorax varies. In the typical form the disc is smooth and the sides only sparsely punctured. In the larger specimens the disc is distinctly punctured but the punctures are always moderate and very sparsely placed. The specimens from the Gulf States are smaller. The largest before me are from Iowa.

Occurs from Pennsylvania to Iowa and Louisiana.

RECENT CONFIRMATION OF AN ASTRONOMICAL PREDICTION.

By Pliny Earle Chase,
Professor of Physics in Haverford College.

(Read before the American Philosophical Society, October 3, 1873.)

In a communication to the Society on the 2d of May last, I gave certain harmonic indications of "a possible unknown planet, planetoid group, or other seat of solar and planetary perturbation" at about $\frac{7}{26}$ of the Earth's mean distance from the Sun.* I also suggested that Wolf's supposed sun-spot period of twenty-seven days "might be readily explained by the perturbations and transits of a planetoid or meteoric group, at a distance which would complete the terrestrial harmonic series." If there is any such source of perturbation, there should be not only maxima and minima of sun-spots at average intervals corresponding with the period of solar rotation, but there should also be subordinate maxima and minima at intervals of a half-rotation, inasmuch as the tidal influence would be exerted simultaneously at opposite extremities of the same solar diameter.

During my summer holidays I was enabled, through the courtesy of Prof. Joseph Winlock, Director of the Observatory of Harvard University, to examine observations of sun-spotted area, extending over a period of nearly five months. They furnished indications of such disturbances as I have described, but the period of observation was so short that I did not regard them as conclusive.

On my return to Philadelphia, I found in *Nature*, of July 17, an abstract of a communication to the Royal Society on June 19, by Messrs. De La Rue, Stewart and Loewy. Those eminent observers adduce evidences of a tendency in sun-spots "to change alternately from the north or positive to the south or negative hemisphere, and *vice versâ*," and they attach special significance to the fact "that *the two outbreaks are at opposite ends of the same solar diameter*." These conclusions are based upon three sets of observations, taken in three different years, and extending over periods, respectively, of 145, 123, and 139 days. Their lowest approximate estimate of the mean interval between two maxima *of the same sign*, is 22.25 days; the highest, 28 days; "the most probable mean value, 25.2 days." The interval between two maxima of the same sign *and originating at the same axial extremity*, would of course be twice as great.

There seems, therefore, to be conclusive evidence of some disturbing force, revolving around the Sun in a period approximately equivalent to two solar rotations. The mean radius vector of such a disturbing force should be:

According to Spörer	.263
" Carrington	.265
" Faye	.266

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* *Ante*, p. [illegible]; see also *New York Tribune*, May 2, 1873.

According to Wolf.................................. .267
" De La Rue, Stewart and Loewy.......... .267
" Herschel (Bianchi and Laugier)......... .268
" Harmonic analogy, a*.................. .267
" " " β.................. .269

COMPARISON OF PLANETARY SERIES.

The closeness of the foregoing accordance may lend interest to a comparison of my own planeto-tactic series with those which have preceded it.

Jupiter, being about two and a-half times as great as the aggregate mass of all the other planets, may be regarded as forming with the Sun a binary star. The mutual action of the two controlling orbs of the system, is greatest at perihelion. A mean radius vector corresponding to the Schwabe sun-spot cycle, would be $(11.07)^{\frac{2}{3}} = 4.967$, which corresponds very closely with Jupiter's secular mean perihelion distance (4.9787, according to Stockwell, which would give a cycle of 11.11 years).

If the mean perihelion centre of gravity of the binary Star, Sun and Jupiter, be regarded as the extremity of a linear pendulum, of which the Sun's centre is the point of suspension, let us designate the distance of the centre of oscillation of the pendulum from the point of supension by a.

$\pi \times a =$ major axis of solar orbit about *c. g.* of binary star...... $= \beta$
$\pi^3 \times \beta =$ Mercury's mean perihelion distance.................... $= \gamma$
$\pi \times \gamma =$ Earth's " " .... $= \delta$
$\pi \times \delta =$ Asteroid at distance $= 2 \times$ Mars...................... $= \varepsilon$
$\pi \times \varepsilon =$ Saturn's mean distance.............................. $= \zeta$
$\pi \times \zeta =$ Neptune's " .... $= \eta$
$\frac{2}{3}\,\eta =$ Uranus's mean aphelion distance.................... $= \theta$
$\frac{2}{6}\,\eta =$ Saturn's " " .... $= \iota$
$\frac{2}{9}\,\eta =$?
$\frac{2}{12}\,\eta =$ Jupiter's mean perihelion distance.................. $= x$
$\frac{1}{3}\,x =$ Mars's mean aphelion distance........................ $= \lambda$
$\frac{1}{5}\,x =$ Earth's mean distance................................. $= \mu$
$\frac{1}{7}\,x =$ Venus's " .... $= \nu$
$\frac{1}{9}\,x =$ Mean of Mercury's and Venus's mean distances......... $= o$
$\frac{1}{11}\,x =$ Mercury's mean aphelion distance..................... $= \pi$
$\frac{1}{13}\,x =$ " " distance.............................. $= \rho$
$\frac{1}{15}\,x =$ " " perihelion distance.................... $= \varsigma$

It will be readily seen that all the terms of the foregoing centripetal series are in harmonic progression, and that the controlling influence of Jupiter over the progression is strikingly marked. A closer examination shows that the harmonic series which begins with Neptune's linear centre of oscillation is interrupted by the great masses of Jupiter and Saturn, and that the one which begins at Jupiter's mean perihelion is disturbed by the masses of Earth and Venus. The value of ν is very nearly an arithmetical mean between Venus's mean distance and her mean perihelion distance. The radius of Jupiter's mean linear centre of oscillation ($\frac{2}{3}$ of 5.2028 = 3.4685) is nearly equivalent to $\frac{7}{2}$ of Earth's mean radius vector, or to a radius vector (3 513) at the extremity of which, if the planetary masses were aggregated, the centre of gravity of the solar system would be at the source of the Sun's radiant undulation. From these three units we may derive the following harmonic series :

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*a, assuming Jupiter's radial centre of oscillation as the fundamental unit; β, assuming Earth's mean distance as the unit.

$\frac{1}{1}$ = 3.468	$\frac{1}{1}$ = 3.500	$\frac{1}{1}$ = 3.513		
$\frac{1}{5}$ = .694	$\frac{1}{5}$ = .700	$\frac{1}{5}$ = .703	Venus's mean perihelion	= .698
$\frac{1}{9}$ = .385	$\frac{1}{9}$ = .389	$\frac{1}{9}$ = .390	Mercury's mean distance	= .387
$\frac{1}{13}$ = .267	$\frac{1}{13}$ = .269	$\frac{1}{13}$ = .270	Radius of solar disturbance	= .267
$\frac{1}{17}$ = .204	$\frac{1}{17}$ = .206	$\frac{1}{17}$ = .207	Vulcan ?	= .209

The value above given for Vulcan is the one which satisfies Kirkwood's estimated period for that supposed planet. If the actual values of Venus's mean perihelion and Mercury's mean distance be taken for two of the harmonic terms, and Jupiter's mean distance for the fundamental unit, we shall have the following harmonic series :

1 ÷ 7.1343 = Venus's mean perihelion distance.
1 ÷ 12.8604 = Mercury's " distance.
1 ÷ 18.5865 = .2678 × Earth's mean distance.
1 ÷ 24.3126 = .2048 × " "

There is, therefore, an apparent break in the harmonic progression, at a distance between .267 and .270 of the Earth's mean distance from the Sun, and within those limits we may reasonably look for the source of the peculiar sun-spot disturbances, which were pointed out by Messrs. De La Rue, Stewart and Loewy, in the communication above referred to.

The closeness of the approximations in my circular and harmonic series is shown in the following table. I take as the basis of my calculations, Bessel's valuation of Jupiter's mass (1 ÷ 1047.879), and Stockwell's estimate of Jupiter's mean eccentricity (.0431601). Sun's radius is taken as the unit. The error of the theoretical value is found by dividing the difference between the theoretical (T) and observed (O) values by the observed value.

CIRCULAR CENTRIFUGAL AND HARMONIC CENTRIPETAL SERIES.

	T.	O.	Error.
α	.680	.680	
β	2.136	2.132	+ .0020
γ	66.224	68.488	— .0330

	T.	O.	Error.
δ	208.048	207.583	+ .0022
ε	653.600	654.760	— .0018
ζ	2053.346	2049.514	+ .0019
η	6450.776	6453.731	— .0005
θ	4300.517	4306.485	— .0014
ι	2150.258	2148.609	+ .0008
κ	1075.129	1069.623	+ .0052
λ	358.376	353.263	+ .0145
μ	215.026	214.860	+ .0008
ν	153.590	155.415	— .0118
ο	119.459	119.293	+ .0014
π	97.739	97.861	— .0012
ρ	82.702	83.172	— .0057
ς	71.675	68.483	+ .0466
Sum	18059.281	18053.947	+ .0003

The assumed "failure" of Bode's series, in the case of Neptune, disappears if we make the series symmetrical, as I have already suggested, by introducing two equal differences at the outer, as well as at the inner limit of the planetary belt. In the following table, Earth's mean distance is taken as the unit.

BODE'S SERIES, MODIFIED.

	T.	O.	Error.
☿ *m**	.4	.387	+ .0333
♀ *p*	.7	.698	+ .0029
⊕ *m*	1.0	1.000	.0000
♂ *a*	1.6	1,644	— .0269
♃ *m*	5.2	5.203	— .0005
♄ *a*	10.0	10.000	.0000
♅ *m*	19.6	19.183	+ .0217
Ψ *p*	29.2	29.735	— .0180
Sum	67.7	67.850	— .0022

The following table exhibits Peirce's phyllotactic series of sidereal periods† in the form in which the original investigation was made by Dr. Thomas Hill, in 1849, at Professor Peirce's request. For convenience of comparison with other series, I give not only the error (α) of time, but also the corresponding errors (β) of mean distance, (γ) of mean or perihelion distance.

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* *m*, mean; *a*, mean aphelion; *p*, mean perihelion.

† Proc. Amer. Assoc., v, 2, Cambridge meeting.

PEIRCE'S PHYLLOTACTIC PLANETARY SERIES.

	T.	O.	Error α	Error β	Error γ
♆		[60127]			
♅ $\frac{1}{2}$ ♆	30063	30687	— .0203	— .0136	*m* — .0136
♄ $\frac{1}{3}$ ♅	10229	10759	— .0493	— .0331	*p* + .0152
♃ $\frac{2}{5}$ ♄	4304	4333	— .0067	— .0045	*m* — .0045
Ast. $\frac{3}{8}$ ♃					
♂ $\frac{5}{13}$ Ast.	625	687	— .0902	— .0611	*p* + .0180
⊕ $\frac{1}{2}$ ♂	343	365.26	— .0609	— .0410	*p* — .0071
♀ $\frac{8}{13}$ ⊕	224.7	224.7 .	.0000	.0000	*m* .0000
☿ $\frac{2}{5}$ ♀	89.88	87.97	+ .0217	+ .0144	*m* + .0144
Sum	45878.58	47143.93	— .0269	— .0180	— .0033

Chauncey Wright, in the Mathematical Monthly, vol. 1, p. 244, referred the phyllotactic law to nodes of extreme and mean ratio, which he called "the *distributive ratio*." The same law which distributes leaves most evenly around the stem, would distribute planetary perturbations most evenly around the Sun.

Kirkwood (Proc. Amer. Phil. Soc., v. 12, p. 163) gave a harmonic series which differed from Peirce's phyllotactic series by the omission of the asteroidal term, and by the substitution of $\frac{1}{6}$ ♃, $\frac{1}{12}$ ♃, and $\frac{2}{3}$ ⊕, for $\frac{5}{13}$ Ast., $\frac{1}{2}$ ♂, and $\frac{8}{13}$ ⊕, in the expressions for the periodic times of Mars, Earth, and Venus, respectively. His approximations were closer than Peirce's for Mars and Earth, but not so close for Venus. The omission of any terms which depend directly upon the asteroidal belt and upon Mars, renders his series less symmetrical than Peirce's.

In the following table, the errors of the closest planetary approximations in each series are given for the purpose of comparison :

ERRORS OF THEORETICAL PLANETARY POSITIONS.

	Bode.	Peirce.	Kirkwood.	Chase.
☿	+ .0333	+ .0144	+ .0144	— .0057
♀	+ .0029	.0000	+ .0001	— .0118
⊕	.0000	— .0071	— .0079	+ .0008
♂	— .0269	+ .0180	+ .0337	+ .0145
♃	— .0005	— .0045	— .0045	+ .0052
♄	.0000	+ .0152	+ .0152	+ .0008
♅	+ .0217	— .0136	— .0136	— .0014
♆	— .0180	.0000	.0000	— .0005
Sum	— .0022	— .0018	— .0015	+ .0001

All of these approximations are so close as to preclude the idea of merely accidental coincidence, and to encourage an attempt to find some causal nexus through which they may all be referred to the law of gravitation.

Peirce's series has the special merit of being the first for which any reason was given. It represents the *mean* planetary distances more nearly than either of the other series, and if we accept the nebular hypothesis, we may perhaps regard it as indicative of the initial tendency to planetary aggregation, inasmuch as we may reasonably suppose that the phyllotactic, or "distributive," ratio was most operative when the nebulous diffusion was greatest.

Bode's series, like Kepler's laws, seems to have been at first merely empirical. But if we conceive a rotating nebulous mass, with a slight equatorial nucleus of condensation, the line of particles between the nucleus and the centre will be influenced by tendencies to two different kinds of motion: first, as portions of a rotating mass, with velocities varying as the distance; second, as revolving particles, with velocities varying inversely as the square root of the distance. The first of these tendencies, combined with the moment of inertia, would urge such particles as were free to move, towards the linear centre of oscillation. If Mercury's mean distance be taken as the point of suspension, Uranus is situated approximately at Neptune's linear centre of oscillation, and each of the planets between Uranus and Venus, is at the linear centre of oscillation between the next superior and the next inferior planet.

My own series is based on the hypothesis that undulations excited in the elastic æther, like those of air, strings, and other elastic bodies, tend to produce harmonic as well as equivalent undulations. The orbital motions of planets, may be regarded as tangential undulations which have been deflected into circles by the continual influence of gravity, and the equivalent radial undulations seem to have determined the π series of groupings in planetary pairs, while the harmonic undulations have been most operative within the planetary belt, where the planetary and æthereal vibrations are in constant mutual inter-action. It will be seen that the mean error of Bode's eight terms (.0022), is more than seven times as great as that of my sixteen terms (.0003), and nearly twenty-seven times as great as that of the eight terms in my series which are directly comparable to his (.0000822). I can think of no mode of gravitating action which will account for such close accordance, as well as for the modifications of the harmonic series by planetary mass and the confirmation of my harmonic prediction, except the one I have already mentioned, the influence of equivalent and harmonic vibrations in an indefinitely elastic æther.

All of the terms in each series, except the Bodeian term for Neptune, *represent actual planetary positions*, or positions within the secular variations of planetary eccentricity. Stockwell's discussion of the secular variations of the orbital elements of the eight principal planets, has shown that the most important of the correlated apsides are the same as are represented in my harmonic series, for he has pointed out the following curious relations:

"I. The mean motion of Jupiter's perihelion is exactly equal to the mean motion of the perihelion of Uranus, and the mean longitudes of those perihelia differ by exactly 180°. II. The mean motion of Jupiter's node on the invariable plane is exactly equal to that of Saturn, and the mean longitudes of these nodes differ by exactly 180°."

Jupiter's perihelion is therefore properly comparable with the aphelion of Uranus. A like comparability with Saturn's aphelion is not immediately evident, but "the orbit of Saturn is affected only by the *difference* of the perturbations by Jupiter and Uranus;" Saturn and Jupiter always act on the inclination of the orbit of Uranus in opposite directions; "the eccentricity of the orbit of Saturn always increases, while that of Jupiter diminishes, and *vice versa*;" therefore while either apsis of one of the planets is approaching the Sun, the corresponding apsis of the other planet is receding and the opposite apsis approaching. Then, if we look only to secular mean positions, Jupiter and Uranus are simultaneously in opposite apsides; and opposite apsides of Jupiter and Saturn are simultaneously approaching to, or receding from, the Sun.

The fundamental centre of oscillation which forms the unit of the π series, is determined by Jupiter's mean perihelion, with which, as we have just seen, the mean aphelia of Saturn and Uranus are correlated, and the same harmonic relations which subsist between these three important planets, fix, with close approximation, cardinal positions of the other planets.

If planetary positions and times have been determined by mutual gravitating action, it seems probable that in planetary masses and in the normal undulations of the æther itself, simple relations to the same action may be traceable. Stockwell says (p. xvii), "a comparison of the values * * * has suggested the inquiry whether there may not be some unknown physical relation between the masses and mean distances of the different planets." I believe that Proctor, and probably other astronomers, have also suggested such a relation, but I am not aware that one was ever pointed out until I called the attention of the Society (Proc. Amer. Phil. Soc., xiii, 141) to the equality between the mean moments of inertia of the two principal planets (Jupiter, $5.2028^2 \times 9543 = 258318$; Saturn, $9.5389^2 \times 2856 = 259851$).

Of the many correlations of light and gravity which I have hitherto indicated, the two following seem especially interesting in this connection. 1. The synchronism between the passage of a luminous undulation from the Sun to the centre of oscillation of the outermost planet, and the rotation of the Sun on its axis; 2. The equality of the limiting velocity of rotation to the velocity of light. In my original announcement of this equality, I introduced, as one of the elements of my calculation, the Sun's centre of spherical gyration. To this the very reasonable objection has been urged, that we know nothing of the internal density of the Sun. I therefore submit the following considerations, which are entirely independent of solar density.

In particles moving freely about an attracting centre, the mean ($4r \div t$) velocity of oscillation through the centre of gravity, is to the velocity ($2\pi r \div t$) of synchronous circular revolution about the centre of gravity, as 2, is to π. The velocity acquired by falling, from an infinite distance, to the extremity of any radius, is $\sqrt{2gr}$. If we suppose that the velocities of free oscillation and revolution are each retarded in the same proportion at the surface of the rotating Sun, and designate the mean velocity of retarded oscillation by v_1; the velocity of infinite fall by v_2; under any assumed expansion or contraction of the Sun's mass, $v_1 \propto \frac{1}{r}$,* while $v_2 \propto \sqrt{\frac{1}{r}}$. If we wish to find the limiting velocity v^0 for the value of r, ($r^0 = r \div x^2$), which renders $v_1{}^0 = v_2{}^0$, we have the equation

$$v^0 = v_1{}^0 = v_2{}^0 = v_1\, x^2 = v_2\, x$$
$$\therefore x = v_2 \div v_1$$

Taking Norton's estimate of solar radius (425,061.5) the value of v_2 is 375.5 miles per second, and various estimates of the time of solar rotation give the following values of v_1 and v_0.

	v_1	v_0
Spörer..............................	.799	176,440
Carrington..........................	.788	178,920
Lelambre............................	.787	179,210
Faye................................	.785	179,660
Petersen............................	.781	180,470
De La Rue, Stewart and Loewy......	.781	180,560
Herschel, (Bianchi and Laugier)......	.777	181,460
Harmonic prediction ($\frac{7}{26}$ ⊕)..........	.771	182,800

The velocity of light, as deduced from Norton's value of solar radius, is 183,450 miles per second, which is approximately identical with the limiting velocity, v_0.

TRANSCRIPT OF A CURIOUS MANUSCRIPT WORK IN CYPHER, SUPPOSED TO BE ASTROLOGICAL.

By Pliny Earle Chase.

(*Read before the American Philosophical Society, October 3d*, 1873.)

The work, of which I have prepared the accompanying transcript, was bought in Amsterdam, about seventy years ago. It consists of forty-four manuscript pages, on twenty-four triangular leaves of parchment, measuring nine inches on a side, substantially bound in a hog-skin cover. It has been kept in a plush-lined tin case, so that it is in a state of excellent preservation, and appears as if newly written. On the lid of the case is a figure of a dragon, together with the following inscription, greatly defaced, but still distinct enough to be perfectly legible.

"Ex Dono Sapientissimi Comitis St Germain Qui Orbem Terrarum Percucurrit."

The cypher consists of twenty-six arbitrary characters. In preparing to transcribe it, I counted the number of times each character was used, substituting *a* for the one that occurred most frequently, *b* for the next in frequency, and so on. The words are often run together, but there are numerous breaks, which I have indicated, some of which appear to mark divisions between words, while others may be arbitrary, or intended as blinds.

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* In consequence of the law of equal areas.

19

p
bzi
db eig
qhg ogcs
darfac kbfce
ihc jaccgaljac
kaccgaljac eifj
aogeadamifkdb bnaf
afchgeaehgfoi qhadbcja

20

cjac acmdgec bqhgvbg
kiffa ja mihoigdkam
daogkad bhuxkajbfh
ge aflinnaflbf
ekh lieaihca
jacajacij
agj saf
kgcb
e

21

j
abnbf
jalgbp
pbedbfbogi
dgpdbj
eajbdi
khlieaihc alihl
ua ja cijagj

22

ajbfb
jambp
hcebaj
euaddhp
ciebdali
gjgpbmbl
kh liea
jamj
hc

23

a
jaha
kajidgea
jagb
ajgfb
bngrbpgdaj
kh liea ja mjhcpbc
kajidpgea
makghpbz

24

tgbjalubn
lu bdcgaj
ehtadbc aflidkhliea
ihc ajacajacijag
j jgfoi lbegif
chgobfea mdi
ceadfaoad
ejbead
da

25

fih
coihc
gfoiqhi
f wbjbenb
sjangdie
jalgbpseajbd
uadgpbrs bdfiogi
edbpb s bgie
bfgaj sjakgnbe

26

vbfbajs lbjybc
jabci s ogbfiaj
sfihc oihcidkiff
ifc mbd lajhgmbd
qhg ciheacl
uic acife
acatbge
csmbd
cih
c

27

jac
bheac
fincka
j aeafajs
mbd lajhgka
wbfikb
aj
nguijac
uijba yapieu

28

fijgl cbz
s fiebnnbdrbeae
qhg acejac agrfa
hdkg ah ajaoa ka
oihcdamdaca
fead md ack
alaeidp
geag
fog
c

29

gp
jan af
e skana
tbgdaliff
igeda mbd hfa
vhcea gfcmgdbeg
if cgoihcn afvhr
akgrfa mhdaeakanif
bna mbdjb jac jg ahxih

30

gj wbkac ngfack akgb
nbfe kid skbdrafe la
hxqhg dalajafeka
cluicac mdalg
ahcac madkha
ckbfcjac nadc ka
mdiji
fra
d

31

nb
ogac
bgfasv
hcqhbhkajb
khf cgalja va
oihckanbfkal
actboahdc cbfc qh
va aflihdafgkbfrad f
lgcqha fgmadggj mbd

32

wsoqh bkbn blinmdg
c mbd jafink brjb mdhi
jbmdacadobogifka
jieuscb tbngjj
a khtahka cik
inaskarin
niddr mb
djafi
nka

33

vi
eu mi
hdjbkaj
godbflaka
vblipkajbm
adcalhegifka
ciftdada mbdlah
xka cigrbk wbfikb
euaic ih fiebnnbdrb

34

mbd jac bhedacfinc
ihe mhgccbfe qhgo
gesd arfaoadgeb
pjanafe eajjaace
jboijifeaka
lajhg qhg
ldabeih
eskif
ej.

35

an
mgda
acechd
eihe mihd
eihcjac cga
ljackac cgal
jac eifjaogead
amifkdb bnaf
ehmjbladbc chdebeaea

36

bhaljbnbgfrbhluajbt
guhdaqhaeadanaeedb
eifjaogea bjidc cg
eifbnaaceodbg
nafemhda ajja
cajaoadb eh
eacafegd
bic gf
img
da

37
eh
mdae
adbchf
aidagjj
abeeafegoa
beihe laqhaj
acacmdgecbadg
afc weihttadife b
gbfc cigakaedbladka
jbkdigeabjbrbhluachdh

38
fajbnakb gdb gfeihc
jaclbd bleadac gfc
mgdac qhaehpa
fgdbc afchg
ea mbd lac
niec c
iga
w

39
p
afg
cmbi
euaic eh
fajac linn
hfgqh adbc bma
dciffa lbdehead
afkdigc gfkgrfakanb

40
pifea kgogfas ehf bhd
igc mbc jac hll
ac qhach bcipe
afk acmadad
ehmd afkd
bc b
ji
do

41
jb
tgr
hd aqh
g aeigec
hd ebeaea bo
al jbnananb
gf ehjbcgafkdbc
bkahxnb gfcs mdicca

42
dfa afbkid begifehm ad i
fifladbc lacebd
bleadac
bhfe nkaj aca
dfaj kh kga
hodbg n
bgeda
ka

43
n
if
idmc n
if bna s
nif acmdge
bjjay bjjay af
mbgx daegday oi
hc qh hfkaoihcn bl

44
linmbrfaeihuihdc qh
ajac bhedac ciga
fe mdaec boafgd
jidcqha
uajac
dbmm
ajjad
bg

ON THE LANGUAGE OF THE NATCHEZ.

BY D. G. BRINTON, M. D.

(Read before the American Philosophical Society, December 5th, 1873.)

Of all the native tribes inhabiting the Lower Mississippi, by the common consent of the early travelers the Natchez or Nache were the most civilized. They were located ten or twelve miles below the site of the city which now bears their name, and formed a community of five or eight villages, each ruled despotically by a hereditary chief called a Sun, themselves in subjection to a head Chief, the Great Sun, whose power was absolute over both the life and property of his subjects. In this respect they differed entirely from the tribes around them, whose Chiefs were elective and limited in their control.

The Nache furthermore had unusual skill in the arts, weaving a textile fabric of the inner bark of the mulberry tree, with which they clothed themselves, and displayed in the construction of their dwellings and temples, and in their mode of worship, more developed ideas than their neighbors. They were accustomed to build artificial mounds, to sacrifice slaves and children at their religious ceremonies, to maintain a perpetual fire in their temples, and avowedly to worship the Sun. The only nation with whom they claimed relationship, and who are said to have spoken the same language, were the Taensas, a small tribe near the river, twelve or fifteen leagues above them. This nation disappeared shortly after the settlement of the country, uniting with the Tonicas, who seem to have been also a related people.*

The numerical strength of the Nache is very differently given by the various early authorities, the maximum being 200,000! More sober statements justify us in putting the number of fighting men in the whole nation at about 800 or even 500.

The origin or meaning of the name Nache is uncertain, and neither the Mâskoke or Creeks, nor the remnants of the tribe yet living can give any explanation of it. The former call them simply Nache or Nachvlke (the Nache people.) They have been known at times as the Apple or White Apple Indians, the Apple being the translation given the name of their principal village by the French. This village was twelve miles south of the present City of Natchez, three miles from the Mississippi, on Second Creek, and five miles from the French Fort, Rosalie. As early as 1699, D'Iberville speaks of them as "the Natchez or Tpelois," the latter word, properly Vpelois, being from vpe, meaning apple, or some such kind of fruit.

The attention which this nation has attracted from many writers interested in American Ethnology, and their hitherto unknown affiliations, have induced me to collect from various published and unpublished sources whatever can throw light on their relationship, and also to obtain from representatives of the tribe still living an accurate vocabulary of their language, illustrating its grammar as well as its word-forms.

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* See Penicaut, *Annals of Louisiana*, pp. 125-6; and Charlevoix, *Journal Historique*, p. 433.

This latter had been very insufficiently done by previous writers. In the early French accounts, while we have many and ample descriptions of their villages, temples, ceremonies, government, arts and appearance, not a dozen words of their tongue can be found. Albert Gallatin published a short and imperfect vocabulary, which he obtained from a Nache Chief in Washington, and this, so far, has been the only source of information about the tongue. It was so meagre that no dependable conclusions could be derived from its study.

As a nation the Nache disappeared in 1730. They were the first to recognize the danger to the native population of the advent of the whites, and the first to resist their encroachments. They were also the first to suffer the inevitable destruction doomed ere many generations to overtake their whole race. The brief annals of their historical existence do not embrace half a century, and such as they are I append them, inserting references to the visits of those writers who have described them.

1682. March 26th.—The Chevalier de la Salle plants a cross at the Nache town of the Apple.

1699. Visit of M. de St. Côme and Father Francois Joliet de Montigny. The letters of both have been published by Mr. J. G. Shea.

1700. March 5th.—They conclude a treaty of peace with M. Le Moyne d'Iberville (Penicaut, *Annals of Louisiana*, p. 57).

November.—Visited by Father Gravier, whose letter has also been published by Mr. Shea.

1703. December.—Visited by M. Penicaut, with a war party sent out by M. de Bienville (*Annals*, p. 83).

1707. In company with the Biloxis and Pascagoulas they attack and nearly destroy the Chetimachas.

1716. "First war" with the Nache. They murder some French traders, and M. de Bienville marches against them to compel them to punish the murderers. Their warriors at this time estimated at 800. Fort Rosalie is constructed, finished August 5th. (See M. de Richebourg, *La Première Guerre des Natchez*, and Penicaut, *Annals*, pp. 131–2, both in French's *Hist. Colls. of Louisiana*).

1720. January 5th.—M. Le Page du Pratz, an intelligent young Frenchman, starts a plantation near the Nache towns. He subsequently writes a *Histoire de la Louisiane* (Paris, 1758), containing many particulars about the tribe.

1721. December.—Visit of the Jesuit Father Charlevoix, who records minutely his impressions in his *Journal Historique*, pp. 420–427.

1723. November.—Second war of the Nache (called by Du Pratz, the First.) Bienville with 700 (?) men attacks the village of the Apple.

1725. Death of the Great Sun, Olabalkebiche, the Stung Serpent.

1728. Fathers Poison and Le Petit undertake to convert them, but with indifferent success. A long descriptive letter of the latter in the *Lettres Edifiantes et Curieuses*, Vol. IV.

1729. November 28th.—The Nache attack and massacre the French residents, incited thereto by the demand of the commandant of Fort Rosalie, that they should forthwith vacate the village of the Apple, as he wanted the ground for his own purposes.

1730. January 27th.—They are attacked by the Choctaws, allies of the French.

February.—They are attacked by the French, their villages destroyed, and more than half their number either killed or taken prisoner. The captives were taken to New Orleans, where the women were put to work on the Government plantations. The men, including the Great Sun, were sold into slavery and shipped to St. Domingo to work in the mines, where they soon perished.

The remainder of the nation escaped across the Mississippi and fled up the Red River to a spot about six miles below the Nachitoche town, "near the river, by the side of a lake of clear water, still known as the Natchez lake, where they erected a mound of considerable size, which still remains."[*] Here they were attacked shortly afterwards by the French and the Nachitoches, under the command of M. de St. Denis. Many were killed, a number were driven into the lake and drowned, while the wretched remnant fled to the Chicasa and Creek towns. Although they have continued to speak their own tongue, they have never since attempted any separate organization.

The Nache language was described by the Le Page du Pratz as "easy in pronunciation and expressive in terms." He pretended to considerable familiarity with it, remarking in his chapter on the subject, "I readily learned the peculiar language of the natives." This we must accept with a very large allowance. The Nache, like most Indian tongues, is enormously difficult to a European, and all that M. du Pratz knew of it was probably little more than the current trader's jargon.

He is, I believe, the only author, however, who notes the different modes of speech in use in addressing persons of rank, and those of inferior position. His words in reference to it have been construed to mean that two languages were in vogue. This is not his statement. Indeed he is careful to guard against such an impression. He says, speaking of the dialectical differences between the Suns and the Commoners: "The two language are nearly the same; the difference of expression seems only to take place in matters relating to the persons of the Suns and Nobles, in distinction from those of the people."

The examples he gives, explain this at first sight singular anomaly. They are imperative or salutatory verbal forms. Now there are two forms in the Măskoke and some other Indian tongues in these modes, "the one used toward superiors indicating respect or veneration, the other toward an inferior as a servant or a child."[*] This peculiarity, probably developed in more positive features by a despotic government, constituted no doubt the difference observed by Du Pratz.

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[*] Dr. John Sibley, in the *American State Papers, Indian Affairs*, Vol. I., p. 724. Dumont, *Mems. Hist. sur la Louisiane*, Tome. II., pp. 192, 193, 295.

The vocabulary, which I now present, was prepared very carefully at my request by Mrs. A. E. W. Robertson, of the Tallahasse Mission, a most competent linguist, familiar with the Măskoke by practical use. It was obtained from Mr. Leslie, a pure-blood Nache. As he was unacquainted with English the Măskoke was employed as the medium, and the sounds are given in the alphabet of that language. This contains thirteen consonants and six vowels. The vowel sound of a in *fate*, the th, and the consonants b, c, d, g, j, r, q, v, x, and z, are wanting. The r is introduced to represent an aspirated l, as hl or 'l. The c is pronounced as tch in *wretch*. The w is always soft as in *weak*. The vowel sounds are a as in *fat;* e as in *me;* i as in *pine;* o as in note; u as in rule. The v is the neutral vowel, and is strictly ă short, as in *vocal*. In comparing the words with others in the Măskoke dialects, I have, however, substituted for the c the ch, and for the r the aspirated 'l. The kw of the Nache is pronounced as the English qu. The sh is always a combination, except in es-hok and pus-hvlles.

I have incoporated Gallatin's vocabulary, retaining his orthography, and indicating words from that source by adding after them the letter G.

Again	hvmv
All	lvtvse, latakop, G.
ant	wĕ'le
apple (big-peach)	vpesurer
arm	a'hvlv, ish, G.
ax	iyvmk, ohyaminoo, G.
arrow	eshakwo, G.
Back	u'sus
" lower part	okco'cu
bad	wvtvks, *or* mesmeskep, wattaks, G.
ball	puhshv
beans	popkĕ
bed	pĕ'tkup
bedstead	ha'pvtv'yv
bible (big book)	a'tolser
bird	sorkor, shankolt, G.
" young	sokolenu
black	cokokuph, tsokokop, G.
blackberry	onu
blue	haähsep, haasip, G.
book	a'tol

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[*] Buckner. *Grammar of the Maskoke Lang.*, p. 77. I am informed that Mr. Buckner's exlanation is not quite correct, but the fact is substantially as stated.

boy	kvpena'nu, tamunoonoo, G.
" small	tvmhkvpe'nanu
bread	pĕhĕ'lu, beheloo, G.
breath	heleksĕ'nēs
bear	tsokohp, G.
blood	itsch, G.
boat	kwagtolt, G.
body	iwit, G.
bone	ikwel, G.
brother	kakanesha, G.
buffalo	wastanem, G.
Cabbage	ki
cake	pĕhĕ'lu cvkv'lgup (globular bread)
cat	wenvtu
" young	wenvte'nu
chair	cu'spedĕl
chicken	kvbahtev'
" young	kvbahte'nu
chief	cu'nv, tarnwap, G.
chin	unkwvyv
circular	lutumkuph
clean	kahve'v
corn	ha'kuyv, hokko, G.
cow	wvstan
" calf	wvstanenu
cylindrical	lutugv
child	tsitsie, G.
cold	tzitakopana, G.
Day	we'tv, wit, G.
deer	ca', tza, G.
" young	caye'nu
dog	wvskup, waskkop, G.
" young	wvskupenu
dress, (a)	pv'evlv
daughter	mahnoonoo, G.
Ear	ē'puk, ipok, G.
east	kwahsep, kakunef
eye	oktur, oktool, G.
earth (or land)	wihih
Fire	u'wvh, wah, G.
flowers	kvhvëlu'se
foot	a'tv
" broad part of	atpĕ'sev, hatpeshè, *feet*, G.
frog	ĕcakst
father	abishnisha, G.

fish	henn, G.
friend, my	ketanesoo, G.
Ginseng (white medicine)	omkvhap
girl, large	horv
" little	hole′nu, hohlenoo, G.
good	sokonen, sokone, G.
grass	ē′wēl, ohwell, G.
grasshopper	shela′tkēha
green	poōkup, chwellhayah, G.
God	aleksandiste tza, G.
Hair, or leaves	tōyv
" (of the head)	ĕ′dēn, etene, G.
hand	ē′sv
" the palm	ēspĕ′hsĕv, ispeshe, G,
handkerchief	shemhawes
" large	shemhaweaker
head	a′puyv, apoo, G.
heel	atv′ntcv
igh	es′hvk
og	kwē′hser
" young	kwĕhsele′nu
horse	wvskupser
" young	wvskupsele′nu
house	ĕ′dv, hahit, G.
heart	oontza, G.
hill	kweya, G.
hat	wahiloohie, G.
husband	tamahl nesoo, G.
Indian, red man	tvmh-pakup, tapakop, G.
infant	se′ce
ice	koowatanul, G.
King, or chief	cu′nv
kneepan	oksuyv
knife	pihĕwes, pyhewish, G.
Lake	a′hvyv
large	lĕkep, lehkip, G.
leg, lower part	atka′hkvr
" calf of	atwen′cev
life (breath)	helekső′nēs
lips	e′hecer
lizard	sakulcvcvt
" blue-tailed	chepapv
leaf	tsiatoll, G.
lightning	pooloopooloonul, G.

Male	kvpe'nv
man	tvmh'kvpena', tomhukpena, G.
many	tvlu'en, pookoseh, G.
meat	wen'cev, wintse, G.
medicine	omv
money	nvrkv'tuho'p
moon (white Sun)	kwa'hsep kvha'p, kwasip, G.
morning	tuwa'cen
mouth	e'heyv, heche, G.
muskmelon	yeweskmvtvk
mother	kwalneshoo, G.
Needle	a'tul
negro	cokonuh
night	mvyukuph, toowa, G.
north	cetakuph
nose	la'mve, shamats, G.
no	kooshats, G.
Oak	tssoelekep, G.
old	tapsel, G.
Pants	okvphv'sku
peach	vpesur
person	tvmh
" young	tv'myv
piebald	kvsahtēp
pillow	hĕ'sunts
pipe	hakhesk
place	luhu
plum	ahtvpesur
potato	vcv
pumpkin	yewe'skvyv
pine tree	tsohl, G.
Quickly	somōl
Rain	nvsv, nasnayobik, G.
rib	kutvpker
river (large water)	kuhnsher, wōl, G.
rock	o'fvh
red	pahkop, G.
Saddle	pĕtkupes
salt	wih
scissors	hvpha'wes
sea	wa'rv, kootshel, G.
" large	warsher
shirt	pofhesku
shoes	pupvce, popatse, G.
short	mocmockup

small	cekeskap, (pl) cekestanu (simg) tsikistiktenoo, G.
nake	u'lv, woollah, G.
ow	rowiyv, kowa, G.
soap	kencuahvlles
sour	kvyumhkuph
south (warm place)	hvmepvstek
spherical	popupkup
ars	tuku'r, tookul, G.
ockings	ho'stcahawes
tove	uwvh-luhu
traight	svpupkup
ugar	owih
un	kwahsep, wahsil, G.
veet	cvkvlguph
ster, my	aluwuch, nesoo, G.
y	nasookta, G.
n	akwalnesuta, G.
ring	amekone, G.
one	ohk, G.
nmer	amehika, G.
ble	kenhv'skushvpvt
tall, or long	wvtakuph, *or* wvtvntakuph
teeth	e'ntv, int (*tooth*), G.
thigh	a'nkwvyv
toad	waskv'lkul
tobacco	hakvu, hakshoo, G.
" pipe	hakhesk
to-day	kawet
tree	cuyv, tshoo, G.
turkey	sokorser
" young	sokorselenu
turnip (large cabbage)	ki'ansher
town	walt, G.
Valley	patkop, G.
Wagon	cetu'tukup
water	kuhn, koon, G.
watermelon	yeweskvyap
well! (interject. of assent)	makup *or* makupiye
white	kahap, hahap, G
white man	royokup
wicked (person)	tvmhtvma'te
wild (of animals)	tvmhkoyugo
wisdom	helbunvlles
woman	tvmar, tahmahl, G.
" young (girl)	tvmalenu

warrior	kaastshel, G.
wife	stepe nesoo, G.
winter	kwithitsetakop, G
wolf	uttuwah, G.
wood	tshootop, G.
Yellow	hahiahop, G.
yes	mahkoop, G.
young	tapkoppinah, G.
I	tugĕha, tukehah, G.
thou	uhkehah, G.
lve (this here)	akoonikia, G.
we	tukahanehi, G.

NUMERALS.

One	we'tan	witahu, G.
two	a'wete	ahwetie, G.
three	ne'de	nayetie, G.
four	tenv'wete	ganooetie, G.
five	spĕ'de	shpedee, G.
six	la'hvnvf	lahono, G.
seven	un'hkwv	ukwoh, G.
eight	v'pkvtepes	upkutepish, G.
nine	wete'pkvtepes	wedipkatepish, G.
ten	ogu	ōkwah, G.
eleven	ogu wetan koü'se	
twelve	ogu äwete koü'se	
thirteen	ogu nĕ'de koü'se	
fourteen	ogu tenv'wete kou'se	
fifteen	ogu spĕde kou'se	
sixteen	ogu la'hvnvf kou'se	
seventeen	ogu vnhkwvk ou'se	
eighteen	ogu vpkvtepeskou'se	
nineteen	ogu wetep kvtepes kou'se	
twenty	ogaphv	okapoo G.
twenty-one	ogaph wetan kou'se	
thirty	ok nĕ'de	
forty	ok kenvf	
fifty	ok spéde	
sixty	ok la hvnvf	
seventy	ok vn h kwv	
eighty	ok vpk vtepes	
ninety	ok wete pk vtepes	
one hundred	pu pu we'tan	poopwitahu, G.
two hundred	pupu a'we'te	
one thousand	puputvmse we'tan	pooptalshel, G.
one million	pupu tvmser we'tan	

small	cekeskap, (pl) cekestan tenoo, G.
snake	u'lv, woollah, G.
snow	rowiyv, kowa, G.
soap	kencuahvlles
sour	kvyumhkuph
south (warm place)	hvmepvstek
spherical	popupkup
stars	tuku'r, too
stockings	ho'stcah
stove	uwvh-
straight	svpu
sugar	owl
sun	ky
sweet	ev
sister, my	
sky	
son	
spring	(pl.)
stone	v'ces (pl.).
summer	
Table	
tall, or long	
teeth	
thigh	
toad	DICATIVE FORMS.
tobacco	tĕgusa
" pipe	pĕnĕgusa
to-day	nĕgusa
tree	tĕtĕnĕgusa
turkey	tĕpēgusa
"	lvtvse tĕpēgusa
turni	pĕmpĕgusa
tow want	nĕpēgusa
V thou want ?	pĕnĕguse ?
y ye want ?	pĕmpĕguse ?
do ye all want ?	lvtvse pĕmpĕguse ?
what dost thou want ?	kōs pĕnĕguse ?
do you want water ?	kuhn pĕnĕguse ?
I want to eat	kenhvskus tĕgusa
I want to eat bread	pĕhĕlu hvskus tĕgusa
do you want to go	hahtēs pĕnĕguse ?
I want to go	hahtēs tĕgusa
we two want to go	hakses tĕtĕnegusa
we want to go	pĕhĕgus tĕpēgusa
we two want to go out	weteshvtvnges tĕtĕne'gusa

VERBAL FORMS.

To see	erhvlles
o write	pushvlles
o die	hawvteēs (*sing.*), wewvteēkek (*pl.*)
to kill	tahanks (*sing. obj*), wewvthvlles (*pl. obj*), appawe, G.
to hear	eplehvlles
to lift	hĕkĕrhvlles
o sweep	pĕrhvlles
o wash	cuahvlles (see *soap*).
o cleanse	kahvhvlles (see *clean*).
blacken	cokohvlles (see *black*).
sit	hĕ′ces (*sing.*), hĕtukses (*pl.*).
stand	cashvkes (*sing.* and *pl.*).
come	kahvsahkus (*sing.*), hvhapesahkus (*pl.*).
run	kwvrhēs kus (*sing.*), hĕkĕrhvkes (*pl.*), kwalneskoop, G.
be lost	wvthvkes (*sing.*), wvtvhvkes (*pl.*)
be about	hv′petes (*s.*) ; hvpe′kses (dual) ; wehvkes (*pl.*)
go	hahtes (*s.*) ; haksēs (*d.*) ; pĕhēgus (*pl.*)
have come (?)	hvêhtek (*s.*) ; hvĕksek (*d.*) ; kvpeēkuk (*pl.*)
ie down	hv′ces (*s.*) ; hvtv′ñces (*d.*) ; hvlvhv′ces (*pl.*).
eat	kenhvskus, kimposko, G.
drink	pokoo, G.
to sleep	nanole, G.
to walk	naktek, G.

INDICATIVE FORMS.

I want	tĕgusa
thou wantest	pĕnĕgusa
he wants	nĕgusa
we two want	tĕtĕnĕgusa
we want	tĕpēgusa
we all want	lvtvse tĕpēgusa
you want	pĕmpĕgusa
they want	nĕpēgusa
dost thou want ?	pĕnĕguse ?
do ye want ?	pĕmpĕguse ?
do ye all want ?	lvtvse pĕmpĕguse ?
what dost thou want ?	kōs pĕnĕguse ?
do you want water ?	kuhn pĕnĕguse ?
I want to eat	kenhvskus tĕgusa
I want to eat bread	pĕhĕlu hvskus tĕgusa
do you want to go	hahtēs pĕnĕguse ?
I want to go	hahtēs tĕgusa
we two want to go	hakses tĕtĕnegusa
we want to go	pĕhĕgus tĕpēgusa
we two want to go out	weteshvtvnges tĕtĕne′gusa

we want to go to the river	warvgus pĕhĕgus tepĕgusa
I want to go and come back this very day	hahtes kawe'tvwv kahvsa'hgus tĕ'gusa (to go) (this very day)(to come back)(I want)
I went and came back	e'htene kvkv e'sahgu
we went and came back	peĕkune kvkv ē'pe sahgu
we want to go (*or*, to be) about	hvpekses tĕtĕne'gusa
we all want to go (*or*, to be) about	lvtvse wĕ'hvkes tepĕgusa
many are sitting	kaku'ĕge tvluen
have you any?	nvcepsev?
I have	nvcecv.
the girls all want books	tvmar lvtvse nĕpĕgusa atul
I want to give to all wanting books	lvtvsets nepegusa atul naguses tĕgusa
he excels all	lvtvse pukeluse
to know	hvcoko'wes
I know	tacuka
I do not know	estucoko
know thou	pĕlecoko
to cast away	mehvlles
cast (it) away (imp. sing.)	mehpale
cast (it) not away	mvkvmmehpvl
run thou	kwvrpĕsku
run thou quickly	kwvrpĕsku somōp
go thou	pa'hte
go you two	pa'kse
go ye	pĕpĕgu
give to me	kvba'guce
bring to me	hvbagece
he died	kae'wete
he fell down	mvkvce'ak
let us all go and see it	pĕĕguk lvtvsets erhvles tepĕgusa (going) (all) (to see) (we want)
I am going	tahtva'
to day I am going	kawet tahtva'
now I am going	kawetvn tahtva'
we two want to go and come back this very day	aksek kahvsa'hgus tĕtĕ nĕgusa (having gone) (to come back) (we two want) ka'wetvwv' (this very day)
having gone, he returned	e'htene kv'kvkuno'wesku
many came (yesterday)	tvluen kvkvepe sa'hku
long ago they came	ĕlĕ'nĕēn kvkv-supesahku
we two want to run	awe'nu kwvrhĕ'skus tĕtĕnĕ'gusa
I don't want to be lost	wvthokes ekusattaá

he was lost	kawv'tege, *or* kawvtsugu
we two don't want to be lost	awe'nu wvthvkes ekusattvtvnea'
I having gone, when you you come back, I again will go	pahtek kvbvsa'hkup tvgĕ'ha hvmv maa'tek
I am he, *or* that one	manv ta'v
you are he, *or* that one	manv pvna'a
he is that one	mana a
they are those	manv pvmpeya
do you think it is he?	mana a yepvnuwv?

It will be seen that many of the words in the above vocabulary are compounds. Thus wăs, apparently a generic term for a certain class of animals, appears in the words wvs-tan cow, wvs tanenu calf, was tanem buffalo, wvs kup dog, was kv'lkul toad, wvs kup-se'l horse, and by elision of the last consonant in we nvtu cat (wvs e'ntu teeth ?), and wĕ 'le ant. I know of no such root in the Chahta-Măskōke dialects, but in the Yuche we have a similar series in the form wĕ, we-tenĕ cow, we-yu deer, we-eyu chicken, we-chaw hog, which latter seems the Natchez kweh-se'l hog (se'l the augmentative).

The termination kuyv seems to be similarly generic for edible vegetables, as ha'kuyv corn, yewe's kuyv pumpkin, yewes kvyap water-melon (compare yewes kmvtvk muskmelon).

U'wvh, fire, otherwise spelled wah, and oua, appears in kwahsep, wah sil or oua chil sun, kwa'hsep kvhap moon, wahiloohie G. hot, (from u'wvh, and luhu, place).

A'tv, foot, forms by addition at'vntchv heel, atwen'chev calf of the leg (wen' tchv, meat or flesh), atkahkvr leg, popatse shoes.

Wihih earth, wih salt, and owih sugar, seem allied, the two latter substances probably being regarded as some kinds of earth.

The name of God given by Gallatin is evidently from helekse'nes breath, and is doubtless a translation of the Mas. E svketv emise, Master of Breath. My informants distinctly say the Nache contains no word for God, of native origin.

The accented é before words denoting parts of the body (see mouth, hand, hair, ear, teeth) occurs also in Măs., where it is usually translated *his*, or *the*, as impersonal. The terminal nesoo is also the possessive form from ne, he.

The words for thunder and lightning are distinctly onomatopoetic.

In several instances totally different words are given in the two vocabularies, as for arm, bird, boy, chief, night, etc. These doubtless express different but allied ideas.

There are but few plural forms. The word *tvluen*, many, is generally used with the singular to form the plural, as *lekep tvluen*. Diminutives formed by adding *enu* (also a diminutive termination in Măskoke); and augmentatives by adding se'l are frequent.

Causative verbs are numerous, and are generally formed by the termination *hvlles* to the root. Eple hvlles, to hear, is probably thus formed from *epuk*, the ear. Adjectives and some possessive pronouns follow the low the words they qualify.

The numerals are remarkably simple, and testify to their independent construction in the language itself. The word for one, we′tan, witahu, G., seems allied to a Maskoke word sometimes used for first, hvti-chiskv (= wŭte-chiskv).* The latter again leads us to the Yuche hetĕ, one. The number two is merely this primitive repeated with a prefix, a′ wete, probably *yet one*, or one other, as the German *noch eins*. Three is the same root eta, with the prefix of the third person singular, ne′de, or nay′etie, G., he yet, *er noch*. Again, in the four, tenv′wete, we recognize the word two, a′wete, with the dual prefix te and a euphonic n, te-n-awete, tenv′wete, literally, two twos. The five, spē′de, or shpedee, G, is evidently the palm of the hand held up to show the five fingers ĕspe′hsev, ispeshe, G. (see the vocabulary). Seven, eight, and nine are clearly built up on the root kwv, thus un′h kwv, v′p kwv tepes, wete′p kwv tepes. This radical is common also to these three numbers in the chetimacha, pakhu, tsi khuiau, tek khuian, and the Attacapa eight and nine, ku eta, ku icheta. The ten ogu, oku, is possibly the Chok. *pokoli*, Mik. *pokolen*, ten. Indeed, Dumont gives *pokole* as the Nache word for ten.

In instituting a comparison between the Nache and other tongues, the Chahta-Măskōké stem of languages, which included those spoken over most of the area between the Lower Mississippi and the Atlantic, naturally should first be examined. The principal dialects arè the closely related Choctaw and Chikasaw on the one part, and the nearly equally closely related dialects of the Creek or Măskōke on the other, the latter embracing the main Creek or Maskoke proper, the Hichita, Mikasukie, and Koōsati.

There are no published dictionaries of any of these tongues, and the vocabularies are by no means full. Besides the printed lists of words to be found in the writings of Gallatin, Buckingham Smith, Buckner, Robertson, Schoolcraft, and Byington, I have consulted various manuscript vocabularies, especially one of the several Maskoke dialects, obtained at my request by Mrs. A. E. W. Robertson. The dialects are reerred to by their first syllables.

Again, hvmu—Mas. svnv *chumv*.

Apple, vpesurer, augmentative of vpesur, peach. The prefix vpe is the Choctaw affix vpi, applied to various kinds of fruit-trees, as ot-vpi chestnut tree, fik vpi, fig tree (Luk. xviii. 6).

Beans, popkĕ. Seminole, popka, wild peas.

Bed, pĕ′thup. Mas. pvtakv.

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* H. F. Buckner, Grammar of the Maskωke Lang. p. 28.

Ball, puhshv. Mas. pukko.

Bird, so'lko'l. Mas. su'li, a bird of the buzzard species, as fuchō-su'li, a buzzard duck.

Blackberry, onu. Chok. vni, small fruit, berry.

Boy, kvpena'nu. Mas. chepvne ; the termination enu is diminutive.

Bread, pĕhĕ'lu. Chok. paska. Mik. pvlvste.

Blood, itsch. Hit. bitch-ikchee.

Brother, kaka-nesha. Mik. chachaie (my).

Deer, cha'. Mas. icho.

Eye, oktul. Măs. tu'lwv.

Flowers, kvhvĕlu'se. Chok. pokauly.

Fish, henn, G. Chok. nvni.

Frog, ĕchakst. Chok. shukvti.

Girl, or young woman, ho'lv. Mik. hvlke.

Good, sokonen. Kos. kokanu.

Hair, or leaves, toyu. Sem. tuisi, leaves.

House, hahit, G. Mas. ehati (his home).

Large, lĕkep. Mas. 'lokket.

Lips, See mouth.

Male, kvpen'v. Mas. chepvne, boy.

Many, tvlu'en. Mas. tvlkōs, it is all ; tvlkekōs, it is not yet all, not only.

Medicine, omv. Chok. vpol *uma*, a medicine man.

Mouth, heche, G. Mik. eichi. Chet. cha. This is apparently the word for lips, e'hech'l.

No, koo-shats, G. Mas. ka, or kō.

Peach, vpesur. See Apple.

Plum, aht-vpesur. See Peach.

Potato, vchv. Mas. vhv.

Pine tree, tsohl, G. Mas. chole.

Sea, wa''lv. Mas. wv'lakko, from oewv water and 'lakko great. Kootshel, G. Chok. okhuta pond, with augmentative, sel.

River, wa'lshe'l, Mas. wa'l with augment. sel. See Sea.

Small, chekestanu. Mas. chetke (enu, the diminutive suffix). Chok. iskitinĕ.

Sour, kvyumhkuph. Mas. kvmŭksi

Stars, tu'kul. Mas. vkolaswv

Sweet, chvkvlğuph. Mas. chvmpe

Teeth, e'ntv. Mas. enŭtti, Mik. enote

Tobacco, hakshoo, G. Mik. akchvme'
" pipe: from same root.

Tree, or wood, chuyv, tshoo, G. Probably allied to tsohl, Mas. chule, pine tree.

Wolf, uttuwah. Mas. yvhv

WORDS FROM EARLY FRENCH AUTHORS.

A very limited number of words are given in the early French writers. These I have collected and will examine.

Allouez, Watchers, guards; "leurs Gardes qu, on nomme Allouez," Charlevoix, *Journal Historique*, p. 420. No doubt this is from e'lhvlles, to see, and hence to watch.

Athiocma, that is good, "cela est bon" (Dumont, *Memoire Historique sur la Louisiane*). This is obviously the Chahta achvkma, good.

Caheuch, come (Du Pratz). Evidently from kahvsahkus, in the above vocabulary.

Chichicois, gourds used as rattles (Dumont, I, p. 193).

Choupichoul, a kind of grain, millet.

Coyocop, Spirit, Esprit (Du Pratz). With the affix se'l or chil, great, the Great Spirit; prefixed to techou, or thecou, servants or inferiors, the common appellation of the inferior divinities (Du Pratz). Given in my vocabulary as the word for white man 'loyocop.

Coüy-oüy, the cardinal bird (Dumont).

Hoo! hoo! or hom! hom! An interjection of approval or assent (Du Pratz and Dumont). This is the same in Măskoke (see Buckner, *Maskŭki Grammar*, p. 74).

Liquip, man or chief (Dumont). This is an error, as the word is clearly lēkep, great or large.

Miche-miche-quipy, an opprobious name applied to the lowest caste (Du Pratz), called Puants or Stinkards. I suspect this is an Algonkin word, from the Shawnee miche, bad, mean, and que-essan boys, fellows. A miserable remnant of Shawnees were held as slaves by the Nache (Penicaut, *Annals*, p. 123). Moreover the author of the *Voyaye à la Louisiane*, p. 33, says the native name is *olchagras*.

Nou-kou, or No-co, I do not know (Gravier, *Letter*, p. 142, and Du Pratz). Compare the vocabulary.

the average size of bricks)—and was *very* sparsely interspersed with grass.

Whilst resting some two hundred feet from the summit, on the north-east flank (during a moderate breeze from the south-west) we were surprised by a loud roaring noise proceeding from the other side, precisely similar to that of an express train when crossing a bridge, or passing a rocky wall. It continued for the space of several seconds, exciting various surmises as to its character and cause. Prior to its occurrence not a sound disturbed the pulseless silence. All agreed that it resembled the rush of a railway train, a clap of thunder, or an avalanche of rocks down the mountain side. Hurrying forward to ascertain the facts, nothing whatever could be discerned to furnish a clue to them. The day moreover was perfectly clear,—not a cloud upon the horizon ; and the theory of a clap of thunder was accordingly abandoned. It was suggested that the goblins, who in the days of Rip Van Winkle played nine-pins on the summits of the Kaatskills, might possibly have emigrated like the Mormons to this sequestered spot, and had been nearly surprised at their accustomed game. In a few moments more, however, the phenomenon occurred again, and in this instance to the abundant satisfaction of us all.

A petty whirlwind, such as dashes along our dusty roads in summer, flitted past within some twenty feet, accompanied by a similarly boisterous noise, although not so prodigious as in the first instance. Their identity, however, was unequivocal ; for, bare as the mountain was, the wind was enabled to collect enough of dust to render its gyrations distinctly visible. This was followed by two or three others of like character during the half hour of our stay, but each apparently less noisy than the last. As the sun had just passed the meridian this fact might possibly account for their diminishing energy.

As the second was sweeping by, the writer—in order to measure the violence of its winds—rushed into its vortex. It was not traveling faster than spirited walk, and was about a yard in diameter. Its vertical current, however, was sufficient to invert the skirts of his frock-coat above his head, although its pockets were loaded with specimens of silver ore to the extent of at least one pound each. His hat required to be firmly secured, and although there was not force enough in the wind to disturb his equilibrium otherwise, its effect on the earth's surface developed a noise like that of a quick-moving empty cart over a stony pavement. The loudness of the clamor appeared to be in each case in exact proportion with the violence of the wind, and it is a notable and well established fact, that in distructive whirlwinds, such as tear up trees, the accompanying roar is that of the most appalling thunder.

Having in no instance heard of these phenomena, as occurring on the scale, and under the circumstances here mentioned, the writer deems it well to impart the facts for the due consideration of the curious.

P.

ON THE METEORS OF JANUARY 2ND.

BY PROFESSOR DANIEL KIRKWOOD.

(*Read before the American Philosophical Society, November 21st*, 1873.)

The second of January was first designated as a meteoric epoch in 1839, by the late Edward C. Herrick, Esq., of New Haven, Connecticut. Modern observations of this shower have not been sufficient to determine the rate of its nodal motion: it may be worthy of remark, however, that a progressive movement equal to that of the meteors of November 14th, would bring the display of December 2d, A. D. 848, forward to the epoch of January 2d. The dates of the star showers derived from this swarm, the first being doubtful, are as follows:

1. A. D. 848, December 2d, assumed to correspond to the modern epoch of January 2d.[*]

2. 1825. On the morning of January 2d, a shower of falling stars was seen in Tuscany, Italy. During the display, about five o'clock, a brilliant fireball appeared, which was doubtless derived from the same meteor group.[†]

3. 1835. On the 2d of January, according to M. Wartmann, an extraordinary apparition of shooting stars was observed at Mornez, near Geneva.[‡]

4. 1838. January 2d, a similar display was reported by the same observer.[§]

5. 1839. M. Bravais states that the night of January 2d, 1839, was very remarkable at Bossekop, in Finland, for its great number of shooting stars and a magnificent aurora.[‖]

6 1840. On the night of January 2d–3d a great number of meteors were observed toward morning by M. Duprez, at Gand. At the same time a bright aurora was seen at Geneva, and magnetic perturbations were noticed at Prague.[¶]

7. 1862. A shower of meteors was seen at New Haven, Connecticut, on the morning of January 2d. About four o'clock, as many as three per minute were seen by one observer.[**]

8. 1863. On the morning of January 2d, Mr. Stillman Masterman, at Weld, Franklin County, Maine, saw meteors falling at the rate of 48 per hour. On the morning of the 1st, also, they were unusually numerous.[††]

9. 1864. January 2d, R. P. Greg, Esq., of Manchester, England, and Professor A. S. Herschel, "mapped each about 60 meteors in two hours."[‡‡]

10. 1865. "On the morning of January 2d, 1865, shooting stars were sufficiently numerous to attract the attention, at New Haven, of those who were not aware that unusual numbers were looked for on that morning."[§§]

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[*] Quetelet's Catalogue.

[†] Silliman's Journal, March, 1862, p. 290.

[‡] Quetelet's Catalogue. [§] Ibid [‖] Ib. [¶] Ib.

[**] Silliman's Journ., March, 1832, p. 290.

[††] Silliman's Journ., January, 1863, p. 150.

[‡‡] Ib., May, 1864, p. 445 [§§] Ib., March, 1865, p. 231.

More observations will evidently be necessary to determine the period. The preceding dates, however, may all be represented in the following scheme:

A. D. 849 to 1825..........75 periods of 13 years.
1825 to 1838.......... 1 period of 13 "
1838 to 1864.......... 2 periods of 13 "

It seems, therefore, somewhat probable that the meteors of this group complete a revolution in about 13 years. The showers of 1835–40 indicate, moreover, that the cluster has become so much extended as to occupy five years in passing the node. With a period of 13 years we find the

Mean distance...................... = 5.53
Aphelion " .... = 10.06

or nearly equal to the distance of Saturn.

In the *Astronomische Nachrichten*, No. 1632, Dr. Edmund Weiss, of Vienna, called attention to the fact, that the fourth comet of 1860, in its ascending node, approaches very near the point passed by the earth about the 3d of January. The elements of this comet according to Valz are as follows:

Perihelion Passage	1860, Sept. 28.
Longitude of perihelion	110° 59′
Longitude of ascending node	104° 14′
Inclination	28° 14′
Perihelion distance	0.9537
Eccentricity	1.0000
Motion	Retrograde.

The comet was discovered by Tempel, at Marseilles, on the 23d of October. It was very faint, and but four observations were obtained. It had an apparent diameter of from three to four minutes. Its light was not uniform, but scattered like a small cluster of very delicate stars, insomuch, that the discoverer was for some time doubtful whether it was really a comet." The body in this respect had a striking resemblance to that of 1866, which is associated with the meteors of November 14th.

According to M. Valz the orbit of the comet of 1860 (IV) is a parabola. The observations, however, which were very imperfect, could be [illegible] as well represented by elliptic elements. If it is really the comet of the January meteors, its periodicity must be regarded as at [illegible] probable. It is remarkable, moreover, that on the hypothesis of parabolic motion, the longitude of the comet's descending node differs [illegible] from that of its aphelion. The latter point is, therefore, [illegible] near the orbit of one of the major planets.

If the period be thirteen years, the comet should have returned in the [illegible] of 1873, and the maximum fall of the associated meteors [illegible] about 1877.

A STUDY OF THE STRUCTURE AND EROSION OF BRUSH MOUNTAIN, IN BLAIR COUNTY, PENNSYLVANIA (WITH A MAP).

BY J. P. LESLEY,

Professor of Geology in the University of Pennsylvania.

At one of the meetings of the Society in the summer of 1873, a proof copy of the Map of Brush mountain, bound into this number of the Proceedings, was exhibited to the members, and its most interesting features pointed out.

No detailed description of it seems necessary. Those who are conversant with Topography in its application to Geology will find sufficiently plain indications of the state of things at the Tyrone City Gap and along the Little Juniata River, displayed by the ten-foot contour-lines of the topography, and by the three small vertical sections placed near the geographical points where they were made.

The system of thick and thin contour-lines on the dark and light sides of hills, to bring them into relief, is one which I invented about the year 1855, using it on a large scale for the first time in the construction of my elaborate Maps of Fayette and Westmoreland Counties, made for the Pennsylvania Railroad Company. The effect upon the portraiture of five hundred square miles of that strongly accidented country was very fine ; and was obtained without in any measure sacrificing the scientific accuracy of the work. I have pursued the same plan ever since, and teach it in the Geological laboratory of the Scientific Department of the University.

The Map here given is a heliotype reduction to one-third (linear) of the original drawing, made by James Osgood & Co., of Boston. It is therefore a fac simile ; and every error is exhibited. The only one needing designation is of a grave character, and I hope to present a correction of it at some future time. The narrow, straight and deep little valley which heads southwest between the crests of the mountain, and issues northeast at the centre of the Gap, is not straight at its mouth. It bends down stream somewhat, allowing the southeast shoulder of the northwestern ridge to project into the Gap, in the same style as does the southeast crest ridge on the opposite side of the Gap ; only in a reverse direction ; that is, down stream instead of up stream. This may be considered a venial error of detail, but it is not ; for it casts a shadow on the demonstration that the erosion of any one part of Apalachian land-surface relates itself harmoniously with the general erosion of its district ; and yet is differentiated by exceptional parts of structure. The short ravine splitting the mountain on the northeast side of the Gap would have bent southward at its mouth, like the long ravine opposite to it, but for a crush in the red rocks of IV., caused by the same force which has thrown the whole mountain on that side of the river forward (northwestward) about two hundred yards.

This upthrow fault, plainly exhibited by the Map, has undoubtedly determined the point at which the drainage of the Upper Little Juniata River had to pass the outcrop barrier of the vertical measures of IV (Middle Silurian) now constituting the double crested mountain, called Brush Mountain northwest of the Gap, and Bald Eagle Mountain northeast of the Gap.

There are similar faults connected with the issuing points of the Little Juniata and of the main Juniata at their gaps through Tussey Mountain, which forms the descending (S. E.) outcrop of the same measures on the other side of the great anticlinal, ten miles further to the southeast.

Stated Meeting, December 19th, 1873.

Present, 27 members.

Vice-President, Mr. **Fraley**, in the Chair.

A letter acknowledging the reception of his diploma of membership was received from Il Commandatore Prof. Giovanni Capellini, Direttore delle Museo Geologico della R. Universitá, dated Bologna, Nov. 28th, 1873.

A letter acknowledging the receipt of Proceedings of Am. Philos. Society, Nos. 88, 89, was received from the Bureau des Longitudes, dated Observatoire National de Paris, July 29th, 1873.

A letter acknowledging the receipt of Proceedings No. —, and announcing the envoy of the Bulletin of the Mexican Geographical Society, was received from the first Secretary, Sig. Ignacio M. Altamirano, dated Mexico, Oct. 31, 1873.

Donations for the Library were received from the Royal Prussian and Belgian Academies, the Geographical Society and Revue Politique of Paris, London Nature, the Literary and Philosophical Society of Quebec, the Essex Institute, Silliman's Journal, the New Jersey Historical Society, the Franklin Institute, American Chemist, and American Journal of Pharmacy, Coe, Wetherill & Co., of Philadelphia, and the Geographical and Statistical Society of Mexico.

The death of a member, Mr. George C. Schaeffer, at Washington, October 4th, aged 59, was announced by the Secretary.

The death of a member, Louis John Rudolph Agassiz, at Cambridge, Mass., December 14th, aged 66, was announced by Dr. LeConte. On motion, a committee was appointed to prepare suitable resolutions to express the regret of the members of the Society at the loss. The Committee consists of Dr. LeConte, Mr. Lesley and Dr. Carson.

Mr. Holman exhibited, by request of the members, his new method for observing the circulation of the blood, by throwing upon a screen a lime-light image of one water-animal after another, enclosed between two glasses. Cavities are ground out of the glass-slides, of a size and shape to fit the animal's body, restrain its movements and permit the transparent tissue to be focussed on the screen. To protect the creature from the heat a simple apparatus, of india-rubber tubes, permits a constant current of cold water to pass around the subject between the glasses.

On motion of Mr. Walter the thanks of the Society were tendered to Mr. Holman for the very interesting exhibition with which he had obliged the Society.

Mr. Blake presented to the Society, in the name of the Swedish Commission at Vienna, a copy of a work entitled "Results of an experimental inquiry into the mechanical properties of steel, &c, manufactured by Christian Aspelin, Esq., Westanfors and Fagersta Works, Sweden," by David Kirkaldy; illustrated by plates. London: Testing and Experimental Works, Southwark St., S. E., 1873.

He described Kirkaldy's magnificent exhibition in the building at Vienna, and directed the members' attention specially to the distorted circles and squares (engraved on annealed and unannealed steel plates) after tension, proving visibly the universal distribution of the strain and consequent movement of molecules throughout the mass of steel. He thought that an important conclusion might be drawn from this by the physicist discussing such questions in geology as that of the elongation of pebbles in conglomerate rocks.

A discussion took place among the members present, participated by Messrs. Briggs, Lesley, and Rand, and by Dr. R. E. Rogers.

Mr. Blake based his arguments on such facts as those which he had observed, in examining the so-called "Gravestone" slates of California, and pebbly conglomerates of Arizona, in which, he alleged, all the quartz pebbles lying in a mica slate matrix were evidently elongated in one direction. He did not agree with the late Dr. Hitchcock in calling in the intervention of heat and moisture to account for the elongation of the Vermont and Rhode Island pebbles in conglomerate; for Kirkaldy's plates were of cold steel. Physicists must accept as a law the plasticity of all matter, even in a dry and cold state, under sufficiently exacting conditions of pressure and time.

Dr. Rogers considered such an hypothesis very hard to entertain. He did not believe the alleged fact of the elongation of pebbles in conglomerate rocks. The shape of the Newport pebbles was certainly given to them by attrition on the sea beach before the consolidation of the deposits. The elongation of a quartz-pebble in a softer matrix is impossible, because the power exerted can have no firm hold on the pebble, which may change its place in the yielding matrix, but without changing its shape. A conglomerate must be homogeneous like a mass of steel to exhibit the effects portrayed by Kirkaldy, and no such conglomerate exists.

Mr. Lesley agreed with Dr. Rogers in this opinion; but adduced such facts as the sigmoid flexures in gneiss and mica slate rocks, to show that quartz string-veins are sharply bent without fracture, proving the plasticity of quartz. Sometimes these zigzags are so numerous and the plications so sharp, that, if pulled out straight, an unbroken quartz vein would extend hundreds of feet. He said that once, in company with Mr. Edouard Désor, he had found upon the outcrop of the coal measure conglomerate the impression of a calamite stem, crossing matrix and pebbles alike, impressing the quartz pebbles precisely as it impressed the cement between them. He believed in the plasticity of all matter, and that, if we could devise machinery for securing a diamond in a grip strong enough, we could elongate it like steel.

Mr. Briggs reminded the Society that Kirkaldy's visible demonstration had been theoretically anticipated by L'Aimée in his rare and too little known Treatise on Strains within the limits of Elasticity. Indeed, some of Kirkaldy's results are depicted in that work. Mechanical philosophers are apt to assign too high a value to such realistic demonstrations, and too low a value to proofs and conclusions obtained through transcendental mathematics.

The Chairman of the Finance Committee reported the following appropriations for the ensuing year, which, on the recommendation of the Committee were so ordered:

Salary of Librarian	$700 00
Assistant Librarian	360 00
Janitor	100 00
Binding Books	200 00
Subscriptions to Journals	50 00
Insurance	200 00
Hall Committee	200 00
Petty Expenses of Librarian	150 00
Publications, in addition to the interest on the Publication Fund	2500 00
General Expenses, including the commissions of the Treasurer	850 00
	$5310 00

Pending nomination No. 740, and new nominations Nos. 741, 742, 743, 744 were read;

And the meeting was adjourned.

INDEX TO VOLUME XIII.

Members Elected.

* Members who have accepted by letter. † Members who have taken their seats.

Page.
*Ackland, Henry W. 23
*Barker, George F. 212
*Britton, J. Blodgett 265
*Burrows, George 23
*Capellini, Giovanni 211
†Clark, Thomas 23
Dupont, Edouard 211
*Frazer, Robert 23
*Fulton, John 212
*Gougain, Theodore M. 211
Haines, John S. 265
†Harden, John W. 265
*Helmholtz, Heinrich 212
†La Roche, C. Percy 23
*Leconte, John 212
*Leconte, Joseph 212
*Longchamps, Emd. de Selys de 211

Page.
Mommsen, Theodor 212
*Messchert, Matthew Huizinga 265
*Oliver, James E. 23
*Palmieri, Luigi 211
†*Pemberton, Henry 23
*Rand, Theodore D. 212
*Rossi, Giovanni Baptista 211
*Rothermel, Peter F. 23
*Saussure, Henri de 211
*Sclater, Phillip Lutly 211
Smith, Lloyd P. 212
*Snowdon, A. Loudon 265
*Spofford, A. H. 23
Thompson, Henry 211
*Thompson, Sir William 211
Wallace, A. R. 211
†Zentmayer, Joseph 23

Members Deceased.

Agassiz, Louis John Rudolph 505
Durand, Elias 261
Fisher, Joshua Francis 34
Hodge, Hugh L. 155
Holland, Sir Henry 267
King, Edward 253
Liebig, Justus Von 236
McEuen, Thomas 155
Meredith, William Morris 261
Mill, John Stuart 253
Pouchet, M. F. A. 34
Raumer, Georg Von 269
Saxton, Joseph 267
Schaeffer, George C. 505
Sullivant, William 236
Sedgwick, Adam 34
Torrey, John 169
Zantedeschi, F. C. 236

Members appointed to Prepare Obituary Notices.

Carson, Joseph ; Obituary Notice of Elias Durand 261
Humphreys, A. A. ; " " " Gen. G. G. Meade 1
Hilgard, J. E. ; " " " Joseph Saxton 268
Penrose, R. A. F. ; " " " Hugh L. Hodge 155
Read, John M. ; " " " William Morris Meredith 261
Stokes, William A. ; " " " Edward King 253

Obituary Notices read.

Leconte, Dr. John L. ; Obituary Notice of John F. Frazer 183
Bell, Dr. John ; " " " Charles D. Meigs 170

Memoirs for the Transactions.

Frazer, Persifor. *Page.*
On a Hydraulic Problem near Bethlehem 1

Written Communications, published in full or in abstract, in the Proceedings.

Bell, John.
Obituary Notice of Dr. Charles D. Meigs 170

Brinton, D. G.
On the language of the Natchez 483

Blodgett, Lorin.
The Non-periodic Distribution of Heat in the Atmosphere 138

Chase, Pliny E.
On some newly Observed Mathematical Relationships between the Orbits of the Planets 34
Oscillatory Forces in the Solar System 140
Estimation of Solar Mass and Distance from the Equilibrium of Elastic and Gravitating Forces 142
Note on Planeto-taxis 143
Rotation of the Sun, and the Inter-asteroidal Planets 145
Planetary Relations to the Sun-Spot Period 147
Relative Velocities of Light and Gravity 148
The Gamuts of Sound and Light 149
The Music of the Spheres 182, 193
Cosmical and Molecular Harmonics, No. 2 237
Correlations of Planetary Mass 239
Harmonies and Cosmical Rotation 243
Weather Study 248
Planetary Node between Mercury and Vulcan 252, 254
On Anticyclonic Storms 254
Recent Confirmation of an Astronomical Prediction 470
Comparison of Planetary Series 263, 471
Transcript of a Curious Manuscript Work in Cypher, supposed to be Astrological 477

Cope, E. D.
A Contribution to the Ichthyology of Alaska 24
On the new Perissodactyles from the Bridger Eocene 5
On the Short-Footed Ungulates of the Eocene of Wyoming 38
On the Flat-Clawed Carnivora of the Eocene of Wyoming 182, 198
On the Osteology of the Extinct Tapiroid Hyrachius 182, 212

Crotch, G. R.
On the Arrangement of the Families of Coleoptera 75

Genth, F. A.
Corundum, its Alterations and Associated Minerals 361

Harden, J. W.
A Map of Anthracite Collieries 155

Horn, Dr. George H.
Revision of the Species of several Genera of Meloidæ of the United States 88
Revision of the Genera and Species of the tribe Hydrobiini 118
Synopsis of the Histeridæ of the United States 273
Contributions to a Knowledge of the Curculionidæ of the United States 407

Kerr, W. C.
Topography as Affected by the Rotation of the Earth 190

Kirkwood, Daniel *Page.*
On the Meteors of January 2d.. 501

Leconte, John L., M. D.
Obituary Notice of John F. Frazer.. 183

Lesley, J. P.
On the Iron Ores of the South Mountain, with a map.......................... 3
On the Dunning's Creek Fossil Ore Bed, with a map........................... 156
Description of a Micrometer for Field Note Plotting........................... 233
A study of the Structure and Erosion of Brush Mountain, with a map........ 503

Lesley, Joseph
The Outcrop Belt of the East Kentucky Coal-field, with a map................ 270

Marsh, O. C.
On the Gigantic Mammals of the American Eocene............... 255

P..........
An Acoustic Phenomenon in the Rocky Mountains............................. 499

Sellers, W. Coleman
D. J. Holman's Device for the Microscopic Examination of Fluids............ 180

Verbal Communications.

Allen.
On the Fundamental Types of Aztec and other Pictorial Writing............. 34

Blake.
On Kirkaldy's Exhibition in the Building at Vienna........................... 506

Blodgett.
On the Hot Season preceding the Hurricane of the 18th of August............ 261

Cresson, C. M.
Graduated Condenser for the Spectroscope...................................... 34

Frazer, Prof.
On a convenient and cheap Device for giving an Acquired Altitude or Slope to a Lime-light Lanthorn.................. 169
On Specimens of Aztec Sculpture... 210
On Prof. Tyndall's Explanation of the Blueness of the Sky.................... 261

Holman.
On his new Microscope Slide.. 169
On his new Method for Observing the Circulation of the Blood................ 106

Houston.
On the Influence of the Heat-Radiation of the Full Moon...................... 264

Leconte.
On the Report of Strange Noises in the Rocky Mountains, made in the Journal of Lewis and Clarke... 268
Mr. Augustus Fiudler on Gravitation... 258

Lyman, Josiah
On Improved Table Instruments for Plotting and Draughting................. 268

Marsh.
On Prof. Cope's Determinations of the Dates of Papers read before this Society. 182

Rand.
On the Abnormal Rainfalls of August... 261

Seiler.
On Two Magic Lantern Slides for Producing on a screen the Alternately Vibrating Waves of Light, &c.................................. 156

TREGO. *Page.*
- On his Recent Observations on the Iron Ore Deposits of Buckingham Mountain, east of Doylestown, Bucks County, Pa. 264
- Geological Survey 187

Correspondence.

Yale College 38
R. Bavarian Academy 154
W. A. Mansell & Co. 168
Linnean Society 185
East Tennessee University 209
Herr R. Zetzchen, Gesellschaft der Natur Wissenschaften, Chemnitz 209
Victoria Institute 209
Chicago Public Library 236
Ecole des Mines 253
Buffalo Society of Natural Sciences 259
Le Cours Scientifique 263
U. S. Naval Observatory 263
Le père Belcourt 266
Historical Society of Wisconsin 268
Dr. Leopold Just 269

Committees.

Standing Committees 22
Library Committee 183
Finance Committee 182, 508
Publication Committee 263, 269
Special Committee on Chess Knights' Tours 37

Publications.

Proceedings Nos. 89, 90 83
Transactions XV., Part I 267

Correction.

For No. 90, page 255, 5th line from bottom, for "under" read "upper."

Trego. *Page.*
On his Recent Observations on the Iron Ore Deposits of Buckingham Mountain, east of Doylestown, Bucks County, Pa. 264
Geological Survey .... [illegible]

Correspondence.

Yale College .... [illegible]
R. Bavarian Academy 154
W. A. Mansell & Co .... [illegible]
Linnean Society .... [illegible]
East Tennessee University 208
Herr R. Zetzchen, Gesellschaft der Natur Wissenschaften, Chemnitz 209
Victoria Institute 209
Chicago Public Library 236
Ecole des Mines 253
Buffalo Society of Natural Sciences 259
Le Cours Scientifique 263
U. S. Naval Observatory 263
Le père Belcourt 266
Historical Society of Wisconsin 268
Dr. Leopold Just 269

Committees.

Standing Committees 22
Library Committee 182
Finance Committee 132, 508
Publication Committee 263, 269
Special Committee on Chess Knights' Tours 37

Publications.

Proceedings Nos. 89, 90 33
Transactions XV., Part I 267

Correction.

For No. 90, page 255, 5th line from bottom, for "under" read "upper."

A Study,
in ten-foot contour-lines,
Structure and Erosion of Brush
showing the Outcrops of the two
Upper Silurian Fossil Iron Ore
passing Tyrone Gap. Blair Co
Pennsylvania.
P. Lesley, Prof. Geol. Univer. Pa.

Proc. Amer. Philos. Soc., Vol. XIII. *Pl. V*